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The MONTHLY REVIEW

Published by the

American Electro-Platers' Society

A SOCIETY FOR THE ADVANCEMENT OF THE SCIENCE OF ELECTRO-PLATING

Entered as second class matter at the Post Office at Springfield, Mass., September 8, 1930, under Act of August 24, 1912.

Acceptance for mailing at special rate of postage, provided for in section 1103, Act of February 28, 1925, authorized September 3, 1926.

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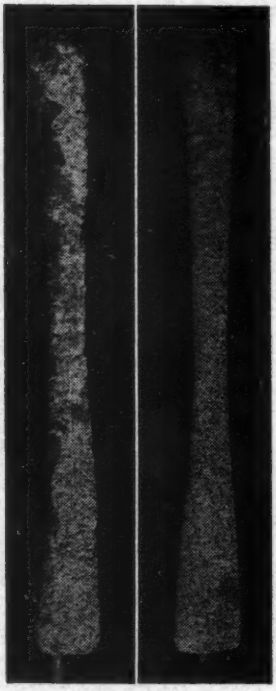

At left: An ordinary high purity zinc anode showing corrosion in zinc plating solution.

At right: ZAM Anode in same solution. (*From unretouched photographs.*)

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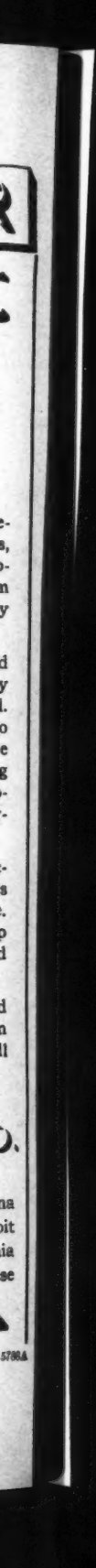

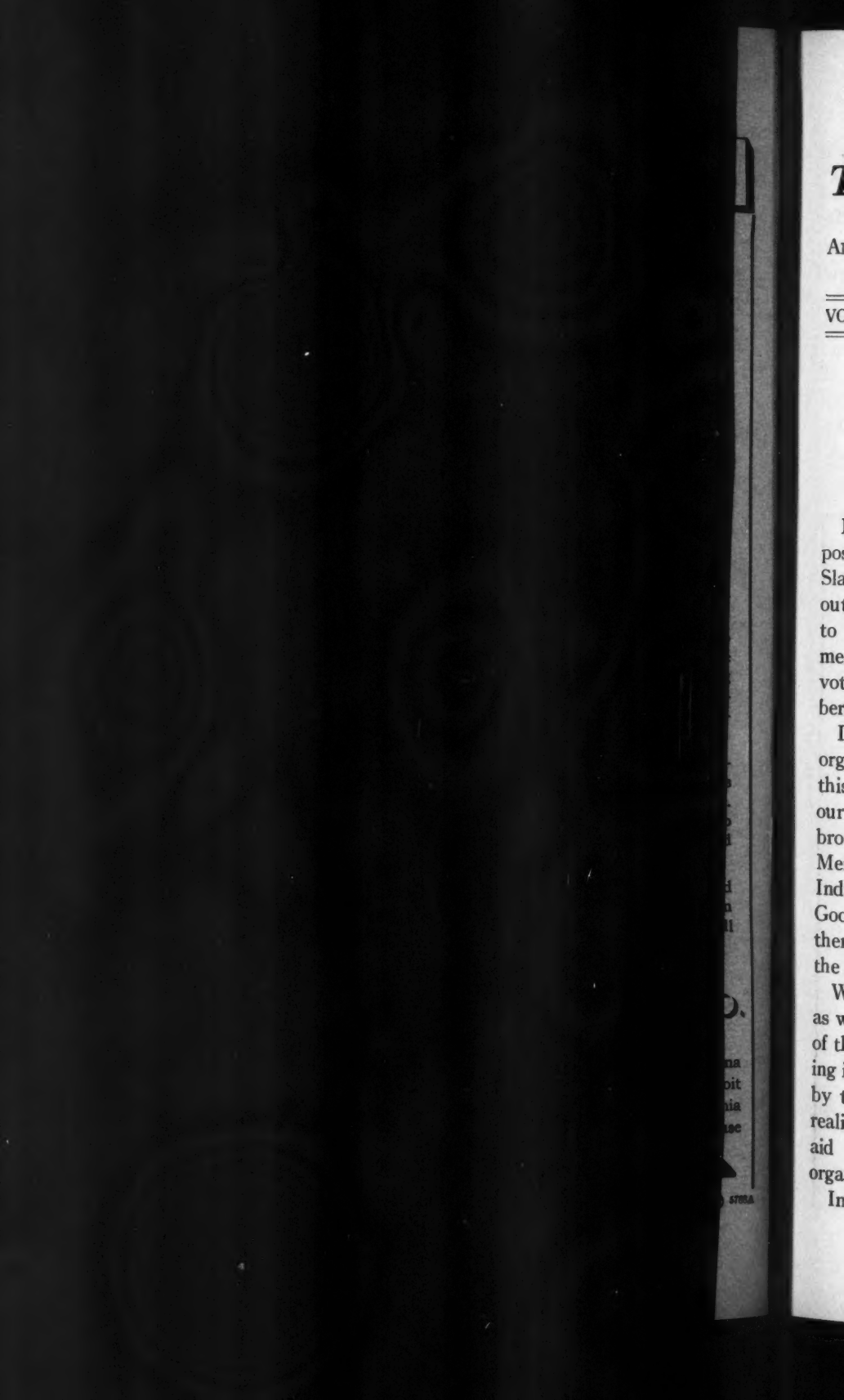

The MONTHLY REVIEW

Published by the
AMERICAN ELECTRO-PLATERS' SOCIETY

Publication and Editorial Office
90 Maynard St.
Springfield, Massachusetts

VOL. XXII NOVEMBER 1935 NO. 11

The Membership Drive and The Good Fellowship Club

Now that the drive to increase our membership is on, every possible means should be used to boost the campaign. President Slattery and Mr. Underwood, chairman of the committee, have outlined methods by which we may accomplish our objective to increase our numbers at least fifty per cent by the time we meet in Cleveland in June, 1936. This should be easy since we voted at the last convention to admit assistant foremen to membership in the A.E.S.

It has been suggested by an exceptionally good friend of our organization, and a member of the Good Fellowship Club, that this latter group, which has done so much along social lines at our conventions, be enlisted in the drive for new members. The brother referred to further suggests that the chairman of the Membership Committee receive from Mr. Trumbour of the Metal Industry, New York City, a complete list of the members of the Good Fellowship Club and mail them application blanks asking them to use their influence on non-members, and explain to them the benefits of belonging to an educational society such as ours.

We are heartily in favor of adopting this suggestion inasmuch as we all realize the enthusiastic spirit dominating the members of this valuable addition to our Society, whose work is manifesting itself more and more each year. The points of contact made by these men from day to day would add considerably to the realization of our ambitions should they undertake to lend their aid in furthering the cause of increased membership in our organization.

Individual members of this Good Fellowship Club have been

boosters right along, and we feel sure that a concentrated effort by the Club as such, in addition to the plans adopted by the branches as a whole, would add the punch necessary to put our total membership well over the two thousand mark by the time we meet at Cleveland next year.

We might also add that if there are others who have helpful suggestions to make, we are sure Mr. Slattery, our President, or Mr. Joseph Underwood, 327 N. 10th St., Camden, N. J. will be pleased to receive them. We also will devote a page in the REVIEW, beginning with the December issue, to show how the Branches are responding to the drive, which by that time should be well under way.

FOUNDED ON EDUCATION, COOPERATION AND IN THE INTEREST OF ELECTROPLATING

Announcing The First

Membership Drive Month

of the American

Electro-Platers' Society, Inc.

December 1935

Heretofore, we have been inclined to sit back and wait for prospective members to come to us. Now, with industry on the upgrade, and assistant foreman eligible for membership, we owe it to the science and industry with which we are affiliated, to contact every potential member in the United States and Canada during December. This will make it possible for these fellow artisans to meet with us for the discussion of mutual problems, education, research, helping themselves and at the same time adding to our strength.—T. F. SLATTERY

Cooperation Between the American Electro-Platers' Society and the American Society for Testing Materials

During the past several years the American Society for Testing Materials has cooperated cordially with the American Electroplaters' Society in various joint activities, such as the exposure tests of electroplated coatings and the preparation of specifications and methods of test. Such cooperation is mutually advantageous, as thereby the members of each organization benefit from the experience and facilities of the other.

In order to make such cooperation most effective, it is desirable for interested persons in each organization to transmit inquiries and suggestions to the appropriate committees, for example through their representatives. The following list of committees and representatives has been prepared to facilitate such contacts. In addition, many persons are members of both organizations and thereby help to correlate their activities. Inquiries regarding any other activities of the A.S.T.M. should be sent to the Secretary, C. L. Warwick, 260 South Broad Street, Philadelphia, Pa.

1. Joint Committee on Investigation of Electroplated Coatings on Steel

American Electro-Platers' Society:

Walter Fraine, National Cash Register Co., Dayton, Ohio.
W. M. Phillips, General Motors Corp., Detroit, Mich.
O. J. Sizelove, 919 Chancellor Ave., Irvington, N. J.

American Society for Testing Materials:

E. V. Mott, Western Union Telegraph Co., 60 Hudson St., New York City.
R. F. Passano, American Rolling Mill Co., Middletown, Ohio.
W. M. Phillips, General Motors Corporation, Detroit, Mich.

National Bureau of Standards:

William Blum, National Bureau of Standards, Washington, D.C. (Chairman).

2. Joint Committee on Exposure Tests of Plating on the Non-Ferrous Metals

American Electro-Platers' Society:

Walter Fraine, National Cash Register Co., Dayton, Ohio.
B. H. McGar, Chase Company, Waterbury, Conn.
W. M. Phillips, General Motors Corp., Detroit, Mich.

American Society for Testing Materials:

J. C. Fox, Doehler Die Casting Co., Toledo, Ohio.
J. R. Freeman, Jr., American Brass Co., Waterbury, Conn.
C. L. Hippensteel, Bell Telephone Lab., 463 West St., New York City.

National Bureau of Standards:

William Blum, National Bureau of Standards, Washington, D.C. (Chairman)

3. Joint Committee on Specifications for Electroplating on Steel.

American Electro-Platers' Society:

Walter S. Barrows, 628 Dovercourt Road, Toronto, Canada.
G. B. Hogaboom, Hanson-Van Winkle-Munning Co., Matawan, N. J.
A. Pearson, Western Electric Co., Chicago, Ill.
O. J. Sizelove, 919 Chancellor Ave., Irvington, N. J.

American Society for Testing Materials:

C. L. Hippensteel, Bell Telephone Lab., 463 West St., New York City.
L. W. Hopkins, American Chain Co., Bridgeport, Conn.
W. M. Phillips, General Motors Corporation, Detroit, Mich. (Chairman)
T. C. Tweedie, MacWhyte Co., Kenosha, Wis.

National Bureau of Standards:

William Blum, National Bureau of Standards, Washington, D.C. (Secretary).

4. Representatives of the A.E.S. on A.S.T.M. Committee A-5 on Corrosion of Iron and Steel

William Blum, National Bureau of Standards, Washington, D. C.
S. E. Hedden, 227 Fifth Street, Aspinwall, Pa.

5. Representative of the A.E.S. on the American Standards Association Sectional Committee on Specifications for Zinc Coating of Iron and Steel (Sponsored by the A.S.T.M.)

G. B. Hogaboom

The Program and Educational Committee

Our 2nd Vice President, Mr. Patrick Sheehan, is chairman of this committee with the librarian of each branch as the local representative and co-worker on this very important activity of our society.

We have but to read and note the very efficient manner in which the Abstract Section of the REVIEW is being conducted to convince the membership of the enthusiasm and personal effort which Mr. Sheehan is giving this committee. He has made arrangements with Mr. R. H. Tingley to furnish articles on such subjects as: Shop Management, Organization, Production, Planning, Personnel and Cost Estimating. These papers will appear in the REVIEW and it is hoped that the branch librarians will read and have them discussed before the members of their respective branches.

Mr. Sheehan is also planning a schedule for speakers who have volunteered through his solicitation to speak before many of our branches. It is hoped that this part of our educational program will do much to bring out a larger number of members to the meetings.

As outlined here, we, as members have placed before us through this committee the opportunities to improve our executive and technical knowledge. What the individual member absorbs from these programs is entirely up to himself, and to make this Committee a success, it is absolutely necessary for the Librarian to contact and consult Mr. Sheehan through the medium of letters, giving a report on programs as conducted by the various branches.

T. F. SLATTERY.

Milwaukee, Wisconsin
October, 23, 1935

To the Branch Officers and Members of the A.E.S.:—

At the twenty-third annual convention held in Bridgeport, Conn., June 10-14, our dear and helpful friend, Mr. A. P. Munning, presented a paper entitled "The Relation Between the Manufacturer and the Plater."

In this paper Mr. Munning claimed that the art of electro-plating embraced three distinct scientific sequences, namely:—1. - Chemical; 2. - Electrical and 3. - Mechanical, and that a thorough knowledge of these essentials is necessary for the plater to carry on his work in an intelligent manner. Further, he stated that the title "Foreman Plater" was obsolete, as it did not adequately describe the position held by the so-called Foreman Plater.

We certainly agree with Mr. Munning in every respect. The plater must have chemical, electrical and mechanical knowledge if he wishes to advance, or even to retain his present standing. The title "Foreman Plater" is indeed as obsolete as Mr. Munning asserts, for the duties of the so-called Foreman Plater are many and varied. To enumerate a few: —

He must make use of records which are immediate, reliable, adequate and permanent.

He must make schedules based upon standards for the efficient employment of time, materials and equipment.

He must dispatch all operations.

He must standardize conditions and operations.

He must make, study and follow written standard instructions.

He must measure and test all methods used by the standard of common sense.

He must give and demand a fair deal.

He must be able to organize and administer.

And he should attend all Branch meetings and enter wholeheartedly into discussions.

So far we have considered the plater only from a Chemical, Electrical, Mechanical and Material angle. But how about the man himself? What is he? Who is he? What are his potentialities? Is he allowing his quest for industrial knowledge to submerge the real man - the man we hope will live when the body ceases to function?

We are happy to announce that we have secured the services of Mr. E. H. Tingley to write a series of six articles dealing with these pertinent questions. These articles will appear in the MONTHLY REVIEW, commencing with this issue.

It is our desire that the officers of the various Branches will make arrangements for free and open discussions of these articles at Branch meetings.

If you study and discuss these articles, we are sure that at their conclusion, you will be a better man, a better citizen, and a better plater.

P. J. SHEEHAN,
Chairman of the Educational Program Committee

Developing a Pleasing Personality

The first of a series of articles by MR. EDWARD H. TINGLEY, Secretary of National Association of Foremen. Arranged for The REVIEW by P. J. Sheehan, Chairman of the Educational Program Committee.

PERSONALITY is not a matter of mystery; nor is it something that can be bought over a counter. Its importance in the life of every individual is readily recognized and while everyone is not equally endowed with favorable traits, the development of an effective personality lies, within reasonable limits, in the hands of each individual.

Personality is the outward manifestation of our inner qualities; it is that combination of factors which makes each individual an identity and sets him off from his fellows. Sometimes the personality which others see in us is vastly different from the one we

may think we express. How well we can do our work, as far as contacts with people are concerned, depends in a large part upon our personality.

The goal each of us strives for, whether consciously or not, is a well rounded personality in which all our native assets may have their full value, and in which our native deficiencies may be compensated for and overcome as much as possible. It is the person with a well-rounded personality who is successful, no matter in what walk of life.

There are certain avenues through which we may express our personalities and to a large extent control what other people will think of us. There are six major traits which may be discussed under the titles of: Appearance, Expression, Intelligence, Interests, Emotions, and Social Adaptation. All these are under our own control, which gives everyone of us the possibility of self improvement.

APPEARANCE. In meeting a person for the first time we pass judgment upon his appearance, because it is the most evident thing about his personality. Appearance is made up of our height, weight, carriage, complexion, clothes, facial expression, etc. Our height and weight we cannot control very much but we can control our posture and carriage. Many men walk with stooped shoulders or shuffle along and this does not prepossess people in their favor. What a fine impression one makes when he walks with head up, shoulders back and chest out. An erect carriage makes our clothes fit better and it is also most important that we keep our clothes neatly pressed and clean. Slovenliness and carelessness of clothes are often considered symptomatic of a general attitude. Our facial expression indicates, in many cases, the type of thinking in our minds. The confident, considerate, kind man has a different expression than the cold, cynical, faultfinding person. The attractive personality shows itself through an attractive face.

EXPRESSION. Our voice is perhaps the most important medium by which we express our personalities. It is not always what we say, but how we say it. A harsh voice may make the kindest words distasteful, but a friendly quiet voice can make the naked truth acceptable. When we are angry or very tired, we tend to shout. Excitement makes the pitch of our voice rise. A

well-controlled voice will lead the listener to infer that we have control also of our emotions.

A person who speaks clearly and pronounces his words correctly, shows conclusively that he is a cultured man. Good enunciation is an asset not only to a public speaker but to the average man in a personal conversation. We can get our ideas over more successfully, when the other fellow understands all we say. There is too great a tendency in the shop, to become slovenly in our speech and slur over the endings of words.

Another problem of conversation is the rate of speech used by different people. The fast talker confuses the slow thinker and the slow speaker irritates the fast fellow who thinks and talks fast. We should adjust our speech to the other fellow's ability to understand.

We display our interests and our reading, as we talk. The shop man uses "shop" terms; the golfer, golf words; the scientist, technical terms, etc. The man who reads a variety of magazine articles and books, seldom is a dull conversationalist. We should also consult a grammar again and learn how to put words into sentences. We all make common errors, but we can correct these mistakes if we but try. Well written books and articles can lead us into the correct use and application of words and phrases.

To talk easily and without embarrassment, to use words correctly, to vary our sentence structure and to adjust the topics of our conversation to the interest of our listeners, is indeed a mark of a pleasing and attractive personality.

INTELLIGENCE. We must not judge a person solely on his appearance and his ease of expression. We must go beneath the surface and learn what he really knows and thinks. Lincoln and Edison would not have been considered great, if they were judged by the neatness of their clothes and hair.

What is intelligence? Simply — it is the ability to learn. Book knowledge should not be confused with the ability to learn. There are two parts to intelligence; memory or the storing up of knowledge and then the ability to solve new problems. By continued and persistent practice, all of us can improve these two abilities.

Memory is absolutely necessary, so that we can build up our intelligence. It can be cultivated, if we but create an interest in what we want to remember and if we pay close attention to what we see or hear. Also we must clearly understand what we desire

to recall or else it means nothing to us later. Association of ideas, people, things, time, etc. all help us to recall past experiences.

The real test of intelligence is the ability to solve problems and to meet new situations. It is more important to be able to do original constructive thinking than to just recall facts. Many people confuse education and intelligence. Intelligence is the natural ability to use our minds, education is the training of our minds, the opportunity to become familiar with the experience of others in the past. So we reflect our intelligence in what we say, how we say it and what we talk about. This leads us to the next topic.

INTERESTS. We always like a person who has interests in common with us. Diversity is also attractive. We are bored by a person of limited ideas but we enjoy listening to one who has travelled or is well read. Our personality grows as we widen our interests. Too many of us limit our interests to our work and home and never broaden out into larger fields of interest and profit. We, too often, say we have no time for these extra activities—too busy now holding down our job. How do we spend our leisure time? To what kind of shows do we go? Are we attending any lectures or evening schools? Are we seriously striving to improve our minds and secure the reward of even being able to find something interesting in life?

EMOTIONS. Our emotions are vast reservoirs of energy. They are defined as a stirred-up state of our body. Anger, fear, love, envy, hate, jealousy — these are translated into various actions, speech and thoughts. There are two channels in which our emotions may go — constructive and destructive. If we let our love lead us into charity, friendliness, patience, tolerance and self-sacrifice, we are well liked by everyone. If we lean towards hate, jealousy, intolerance, vanity and selfishness we are disliked. If our fear gives us courage, industry, caution, righteousness we are commended. If we are cowardly, sensitive, lying, suspicious, we are ignored.

We have all met the pessimist to whom the world is a dark place in which to live; and the optimist, who looks ahead to better days; the seclusive man who keeps everything to himself; the expansive person who tells everybody everything he knows; and the suspicious man who fears everyone.

Our aim is to master our emotions, rather than be mastered by them, to use this great force, which each of us has, towards building a happy, well balanced, useful life.

SOCIAL ADAPTATION. Most of us are striving, either consciously or unconsciously for successful and happy human relations. We want to be judged in the last analysis, according to the way we get along with people. Most of our waking day is concerned with our relations to someone else. We must learn to modify our behavior to fit in with the behavior of other people.

Consideration for others, tact in handling situations, sympathy for the unfortunate, cooperation with others, working for better living conditions, tolerance for the opinions of others, cheerfulness, service, — all make up a good program for social adaptation.

There are three ways in which every individual can improve his personality:

First, he can observe other people who have effective personalities and see what they do or do not do.

Second, he can study the effect he has upon other people with whom he comes in contact.

Third, and perhaps the most valuable aid in improving personality, is the judgment of close friends.

Of course, character counts in the long run, but character alone is not sufficient. How many men and women with sterling characters are prevented from rendering service in this weary world because of unpleasant or forbidding personalities. How many executives and foremen with rugged, honest, loyal characters have trouble in handling men because their personality does not reflect this inner sterling worth.

We have discussed the development of our personalities from the point of view of making the most of our appearance, expressing ourselves to the best advantage, developing our intelligence, learning to control and utilize our emotions and broadening our interests. Why are we interested in these matters? Why do we wish to develop our personalities? Is it not that we may live more happily and congenially with our fellow men? This will make our work easier, our home life more happy and our city a better place in which to live.

Coloring of **Metals**

HARRY MACFAYDEN
Read at Bridgeport 1935 Convention

THE many finishes produced in the Plating Department require considerable thought in selecting the best and most economical method. As there are various plating methods which will produce the same finish, it is essential to be able to choose the proper one for a certain kind of work so as to save labor and material. At the same time, the quality, effect and permanence of the finish must be kept in mind.

For example, many finishes can be produced by immersion processes that are produced by electroplating. I am now going to speak on tin-plating by immersion. This system of finishing has saved our company many thousands of dollars every year. It is very simple, and two men turn out about three tons of work per day. We would have to nickel plate these parts, for the underwriters compel you to identify our ground terminal on all of our electrical wiring devices. Outside parts that are nickel plated, but have no wear, can be tinned instead.

This tinning tank that I have is about twenty feet long. I use iron baskets with 1/16 inch mesh, ten inches wide and twelve inches deep. There are about twenty-five of these baskets in the tank at the same time. The reason I use such a small mesh is so that the operator can use the same basket for any size of material.

Work comes to be tinned in lots of 1/8 pound to 100 pounds. You can now see what time can be saved by having a solution of this kind. All you have to do is to put 1/8 pound of material into the basket and dip it. The work has to stay in the solution at least twenty minutes. It takes just twenty minutes to empty the twenty-four baskets and refill them again. It is just like an endless chain after you get it started. You can leave the work in over night or over Saturday and Sunday, and the operator can start to work at eight o'clock sharp the next day.

It has it all over nickel for looks, and it will not tarnish and is just as good a year after if stored in the stock room that long. You cannot say that about nickel. Now, don't get it into your head that it can replace nickel. It certainly hasn't any wearing

qualities as compared to nickel. If you are going to assemble any article that is not subjected to wear, it is perfect. You have to keep the solution at a boiling temperature to get the best results.

FORMULA:

Tin Solution
Water - 1 gallon
Chloride of tin - 2 ounces
Caustic soda - 2½ ounces
Sodium cyanide - 1 ounce

DEPOSIT OF COPPER BY TUMBLING WITHOUT CURRENT

We have thousands of pounds of small studs and spindles that are only about one-tenth of an inch in diameter and less than half an inch long. I have to give these a copper finish. If I undertook to do this work in a plating barrel or in baskets I would have to have a man watching them all the time. If I put them into a horizontal plating barrel they would get stuck in the panels of the barrel, and I would run the chance of mixing the sizes. So I just throw them into a steel tumbling barrel with potash and give them a thorough tumbling. Then I wash out the potash with running water while they are tumbling. I have a stock solution of copper sulphate two ounces, sulphuric acid one ounce, water one gallon. I throw a gallon of this solution in with the work and let it tumble for half an hour. The work is rinsed while tumbling with running water, and comes out as bright a copper finish as you would want to get.

LACQUER ENAMEL ON GALVANIZED IRON

They tell me some of the boys run into a lot of trouble lacquer enameling sheet galvanized articles. I had the same trouble myself, of not having the lacquer enamel adhere to the galvanized articles. I overcame this by cleaning or brushing the work with ten per cent solution of acetic acid. I do not know what this does, but it removes some film and makes the enamel adhere. You will find that if the enamel will stand bending on brass or steel, it will stand up on galvanized iron after going through this operation. Of course, you know the work has to be washed in clean, cold and hot water after the acetic acid, and dried with air. You must have a good grade of sheet metal in the first place; if not, you will find the zinc coating will flake off in any forming operation.

TUMBLED VARNISH ON PAPER, FIBRE AND BAKELITE

I will pass over metal products for a moment, and talk about sheet paper, fibre and bakelite that has been blanked out in different shapes and sizes that we use in our electrical devices. Now, you all know that all of these articles will absorb moisture, some more than others. In our line this must not happen as all of our switches must stand electrical tests, and if the inspectors find that the current jumps through the paper, fibre or bakelite, someone is going to get into trouble.

To prevent moisture from getting into these parts, coat them with from one to three coats of Valspar varnish. I put about forty to fifty pounds of these into a steel tumbling barrel, then mix one quarter pint of Valspar varnish with one quarter pint of thinner, and pour the mixture into the barrel and let them tumble about twenty minutes or until it is just tacky enough to handle. If I want to give the work another coat, it is allowed to dry in the box over night and given another coat the next day. If the third coat is needed, take the same procedure. Many of you will wonder why they will not stick together, but as a matter of fact they don't.

ENAMELING OF BAKELITE

Some concerns have tried but have never succeeded in making a success of lacquer enameling bakelite. If they will only brush their bakelite over with a special composition (which I will impart to anyone who will ask for it off the platform,) for I am not up here advertising any firm's products; that's why I am not giving that out here, then wash clean in a weak but hot alkali solution, rinse and dry with air, they can then spray the bakelite and will not have any trouble. If you have small parts to enamel and they can be tumbled without injury to the parts, tumble in powdered pumice and water, and then wash, dry and enamel. If you should spray white or ivory on bakelite and it should bleed through to a pink, it is an indication that your bakelite has not been cured enough in manufacture. You cannot get anywhere with this kind of material. It has to be cured thoroughly.

FAKING OF FINISHES

I suppose some of you will get a kick out of this. I don't know whether any of you fellows ever do any of this kind of finishing or not, but I do, and get a kick out of it myself. It was not so

very long ago that we received an order for 10,000 shells to be finished in sand blast antique brass as per sample. Well, you know as well as I do that if you sand blast anything that is 0.0001" thick, that you are going to get it all out of shape.

So what a job that was going to be! Well, did I sand blast them? I should say not, although the sample said "Yes." I sprayed test shells with a mixture of bronzing lacquer, black lacquer and brass powder until I had the right color. Then I made a batch of the same mixture. The operator stood back about eighteen inches and sprayed it on the work. This gave a sand blast effect. After they had dried, I then scratch brushed them lightly with a brass wire wheel. Well, when I had them done you could pick up a shell anywhere in the lot and it would match the sample to a T. Not only that, but every one of the shells would match up with the caps anywhere you picked them up. They went through our inspection and the customer sent in another order for 5,000 more and never registered a kick. You can duplicate a lot of plating finishes and oxidized work with lacquer enamels and powders and do a fine job. I would not recommend this where there is any wear on an article.

FINISHES ON RADIO OR SMALL TOGGLE SWITCHES

Our company finishes a good many hundreds of thousands of radio and toggle switches in a year in all kinds of oxidized finishes. The largest part of these metal parts are relieved and shaded. It all depends on what finish we are working on, what way we have to relieve them. We only do this kind of work on special orders. Sometimes we have a sample and sometimes we don't, but we always know what the customer wants before we start to finish it — no guess work. I have several ways of relieving this class of work. It is all done in steel tumbling barrels. Sometimes we just use sawdust, then we use sawdust and pumice stone, wet sawdust and emery, wet and dry sawdust, and coarse quartz and water, or pumice stone and water. It all depends on just what finish we are working. The operator has got to stand right there and watch it while it is tumbling. He knows just when to stop. Sometimes one minute of over-tumbling will change the finish completely.

STEEL BOXES

These steel boxes come coated with a fire scale. Some are worse than others. These boxes vary in size from 2″ x 4″ up to 24″ x 30″. They all have to be cleaned, scale removed. Some are cadmium plated, some are finished in black, red and gray enamel, and some are finished with gray enamel mixed with a fine aluminum powder. The gray enamel kills the aluminum color so that it does not make it so pronounced. To clean and pickle these boxes, I first clean them in an electric cleaner composed of cyanide, potash and sal soda with reverse current. From there into a hot muriatic electric pickle with a double throw switch. First with the direct current and then with the reverse current, and then back into the electric cleaner, which helps to clean any scum that comes from the pickle, and this also kills the acid left on at the same time. They are then ready for plating and enameling.

A CLEANING METHOD FOR STEEL PARTS, BLANK AND FORMED

I am now going back twenty-eight years, to the time when I first went to the Arrow Electric Company, now the Arrow, Hart & Hegeman Electric Company, one of the largest, if not the largest, of its kind in the world, and where I first discovered a method of cleaning steel parts that I have now used over a period of twenty-eight years, and with which I have had fine success. When I went there, there were only twenty-three hands working in the plant. It was a small place, as you will see. They didn't have a lot of capital at that time, so they had no money to spend for plating equipment or supplies. I had to use half barrels for some of the solutions and rinse tanks. I had only one potash tank to clean everything, for both tank and barrel plating.

The parts came to me right from the forming press with heavy oils. Well, I got into trouble right away, for I cleaned parts for the plating barrel and parts that were to be polished nickel in the same tank. We had no more room to put another tank in, so I had to think and think fast. I took a box of work upstairs where they had a tumbling barrel, and I tumbled it in sawdust. That sawdust at that time was soft pine sawdust and it left a lot of fine dust on the work, but I dumped it into the plating barrel, sawdust, work and all, and it came out beautiful. Well, from that time on I have never potashed a bit of work that I have plated in the plating barrels.

Now you might ask about the cost of the sawdust. I use about $20 worth of hardwood sawdust a week. We bright dip every day around four and five tons of brass, copper, bronze and aluminum, besides tin dipping about three tons of other work per day. I dry all of this work in the dipping room with hardwood sawdust and in the sawdust used in the dipping room we tumble all of our steel parts that are to be brass, copper, cadmium or nickel plated. None of this material sees potash one way or another. It comes right from the tumbling barrel and is dumped into the barrel of whatever solution it has to be plated. I have five cadmium plating barrels, four copper, seven brass, four nickel, with three men to take care of the output of these tanks. Now, if I had to potash this work, you can just see what equipment I would have to have, how much more help it would take, more floor space, the waste of water, steam and cleaner. One man cleans all my work for the plating barrels in three tumbling barrels with sawdust, which sawdust, as you know, all comes from the dipping room. Each barrel cleans a batch of work in four minutes. Now, I know that this is not a good story for the man who sells cleaners, but it is my story, just the same, and I'm still using sawdust as a cleaner.

NICKEL PLATING ON HOT TIN KNIVES, FORKS AND SPOONS

I had an opportunity one time, years ago, to open up a plating department for a firm that made hot tinned knives, forks and spoons. These knives, forks and spoons had to be nickel plated on top of the tin. Now, gentlemen, what procedure would you take to nickel plate those? Well, I was stuck, too. So I just had to think the quickest way out of it, for you know that this material comes from the tinning room all covered with tallow.

The first thing I ordered was five gallons of benzine, some box wood sawdust, and then I went to work. I cleaned them in the benzine, dried them in sawdust, made a very weak solution of rock potash (that was all we had in those days) and a very weak solution of hot cyanide copper. I racked the work up after coming from the benzine, put them through the weak cleaner and into the hot copper. When they came out of this hot copper there was only a very slight discoloration or color of copper on the extreme edges of the work. From there, rinsed in cold water and right into the nickel tank and, gentlemen, do you know I never knew, through the year and a half that I worked there, what one piece

of failed or blistered nickel looked like? I was more surprised at my success than you are as I tell you this story.

In those days we had no place to get any information from or anybody to go to but the old-time plater, and try to get anything out of him!

BLACK CARBONIA FINISH

This finish is one of the finest black finishes for steel and iron that I know of. It is not a perfect rustproof black. It will stand the weather quite well. The work is first washed or tumbled, as you desire. Then 100 pounds of material which must be of steel or iron is put into a gas retort with one-half pint of raw linseed oil. It is tumbled for an hour and a half at a temperature of 650° Fahrenheit. Then it is taken out and dipped into raw linseed oil and put through a centrifugal dryer and whirled until dry. It is then ready for the assembling department.

DELEGATE GEHLING: You say you have two men there continuously. That means you must have continuous production. What do you use for a replenisher?

MR. MACFAYDEN: The man uses about ten pounds of tin and ten pounds of caustic a day.

DELEGATE GEHLING: Ten pounds of what?

MR. MACFAYDEN: Caustic soda and chloride of tin. He takes the cyanide that he uses to bring it up to a bright color before he puts it in there. He throws that into the tin. Then he replenishes the cyanide.

DELEGATE GEHLING: I am running about ten of those tanks myself.

MR. MACFAYDEN: That is the story on that.

DELEGATE GEHLING: We turn out about 2,500 pounds. I do not use it for the same purpose that you do. All these straight pins and hooks and eyes, and so forth, are made of tin and they have to come out bright and silver. We used to sell hair pins that way as untarnishable silver, but they were tin.

MR. MACFAYDEN: I made up that tank when I bought it five years ago. It has never been emptied. The boys handle it themselves, I do not even touch it.

DELEGATE GEHLING: We also use another tin on other stuff there. We use the old cream of tartar. That is an old stunt I learned in Connecticut years ago. We find that is a better process —the acid tin—for the same work, with the exception that it is

not as quick. It takes six hours and with this you can do it in anywhere from five to seven minutes. Our process usually takes seven minutes.

MR. MACFAYDEN: I have these twenty-seven baskets. The boy takes one and washes it. It is washed in two hot waters, for the simple reason that the human element is liable to enter in. If you have screw terminals, with the screw spun in, the man is liable not to get all the tin solution out. That is liable to corrode in there and stick your screw if you do not give it a thorough washing. Each basket takes less than a minute. There is nothing to it at all after you get it started. Another thing: You can leave that in over Saturday and Sunday.

DELEGATE GEHLING: You could save yourself a lot of tin if you took a lot of tin anodes and threw them in the bottom of the tank and let them corrode in there. We cannot dip our work in a bright dip. We have to tumble ours. I have in the neighborhood of eighteen oblique tumblers in which I clean my work. I found it good practice, even after tinning, to tumble some of these things, because then we would do away with the rinsing, as you say, and keep it from tarnishing. You may cuss us when you have to remove eight or ten pins from a new shirt, but we are tickled to death. We would like to have you take forty out of that shirt because then we would sell more pins. Some of the shirt manufacturers put in only two pins, which cuts our production away down.

MR. MACFAYDEN: Your work is a little different from ours. Ours is assembling switches. You can see the tin on our motor control switches down there at the show. You can see the tin work that is done.

Then we have another finish that we use. It is on steel. It is what they call a carbonia finish. It is for small parts that are put in this gas retort. We have a dozen of them, I think. They throw about a pint of raw linseed oil into this retort. The temperature is 650°. It is tumbled for an hour and a half in this gas retort. It comes out, fellows, as beautiful a black as you ever saw on steel. It is not a thoroughly rustproof finish, but it will stand a lot of testing. We use it on our base plates and practically all our

screws are finished that way, because you get a nice uniform color and it stays put. It will be as good one hundred years from today as it will be next week. It is a nice black. Maybe a lot of you fellows do it, but if you do not I will show them to you.

DELEGATE WITTIG: What do you call that?

MR. MACFAYDEN: Carbonia.

MR. FLAHERTY: On the switches that you blacken, do you use a sulphide black or an arsenic black?

MR. MACFAYDEN: I use a sulphide black and barium sulphide.

MR. FLAHERTY: How is the wear on the switches with the sulphide black?

MR. MACFAYDEN: Until it wears off. (Laughter)

CHAIRMAN CHAMBERLAIN: Thank you, Harry.

DELEGATE SHEEHAN: I happen to be one of the unfortunates who must match some of Mr. MacFayden's finishes, and also meet the competition of this concern. There are two questions I would like to ask him. When you varnish the small fibre cards, how do you keep the pieces from sticking together? If you tumble with wet sawdust, how do you keep the sawdust out of the blind holes?

MR. MACFAYDEN: We don't have any with blind holes in them.

DELEGATE SHEEHAN: How do you keep the very light fibre from sticking together?

MR. MACFAYDEN: By not adding too much Valspar. You can make every piece stick if you put in too much Valspar. You have to use your head a little bit and get the Valspar down in quantity so that it only covers the material.

DELEGATE SHEEHAN: What is the object of using a thinner with the Valspar? I assume you are using lacquer thinner.

MR. MACFAYDEN. Yes. For the reason that it dries much quicker. I put in a half pint of Valspar varnish and a half pint of thinner. I have used turpentine in place of that. However, it takes longer to dry. I use the thinner in place of the turpentine so that it will dry quicker. It dries in about twenty minutes.

The Air Conditioning of Lacquer *and* Plating Rooms

A. WILSON KNECHT

Read at Bridgeport 1935 Convention

MR. Chairman and Gentlemen: The application of air conditioning to the solution of industrial problems is not new. Within the past decade, such great strides have been made in the science of air conditioning that we are now inclined to accept it as an important adjunct to our manufacturing facilities. Applications to all industries, however, have not yet been made, and it is with the thought that your industry may be benefited by the development of this new science that this discussion is presented.

Before proceeding, it might be wise to definitely describe what is meant by air conditioning. It may be broadly defined as the science of producing and maintaining specified atmospheric conditions in a given space. To produce such conditions, it might be necessary to heat, cool, humidify, dehumidify, and/or purify the air being delivered to that space. Which of the foregoing operations are utilized, either singly or in combination, will depend on many factors.

It will be noted from the definition that air conditioning includes ventilation in so far as the maintenance of pure air conditions is concerned. This refers particularly to exhausting systems as used industrially for the removal of harmful dusts and gases. However, this discussion will deal only with those phases of air conditioning which are comparatively new additions to the art, such as the means of cooling and dehumidifying. Nevertheless, we must not lose sight of the fact that properly designed exhaust systems are absolute necessities in some industries, if more healthful working conditions and decreased accident hazards are required.

In order that air conditioning may be accepted in any industry, it must be definitely proven that the expense incurred in the installation and operation of the system will be returned to the owner in the form of increased profits or that other tangible advantages will be obtained. An increase in profits may be realized in many ways, the most obvious of which are: first, fewer rejections; and secondly, improved work with equal or less expendi-

ture of time on the part of the workmen. Other advantages such as better morale among the workmen, less time loss due to respiratory diseases, and the like must be taken into consideration.

No attempt will be made to evaluate air conditioning systems in the terms of increased profits or other advantages, but the discussion will be limited to a presentation of the costs and advantages of the various types of systems. It is hoped that sufficient information will be given to enable the operating executives to serve as their own judges in the determination of whether or not an air conditioning system will be of economic or material advantage in their respective plants.

The major problem of your industry which may be alleviated by the proper control of atmospheric conditions is that encountered in lacquer rooms on humid days, namely, the "blushing" or "whitening" of the lacquer film immediately after its application to the work. It is a well known fact that the drying of lacquers is caused by the rapid evaporation of the lacquer solvents. As the evaporation progresses, the film is cooled to a relatively low temperature. Should the atmospheric conditions in the workroom be such that before the film has set it is cooled below the dew point temperature of the surrounding air, or that temperature below which the air can no longer retain all of its moisture, some of this moisture will be condensed on the surface of the film. The moisture on the surface of the partly dried lacquer film has a tendency to throw the solids out of solution, producing a whitish or cloudy appearance. The tendency toward blushing is also increased by allowing a draft of air to strike the work while it is drying.

It would appear, then, that should the atmospheric conditions in the lacquer room be controlled in such a way that the surface of the work will never be cooled below the dew point temperature of the surrounding air, and that should the further precaution be taken to control the air movement so that drafts will not strike the drying work, two of the most important causes of blushing will have been removed.

Obviously, the suggested method of eliminating blushing may be used during all seasons of the year. The result would be that work may be carried on during humid, muggy days and that shut-downs due to weather conditions would become a thing of the past. Furthermore, "borderline" days would be no more,

with total elimination of rejected work caused by the attempt to carry on under unfavorable conditions.

It must be borne in mind, however, that air conditioning is not a cure-all for blushing. For instance, that blushing which is caused by the concentration of higher boiling solvents which sometimes causes solids to be thrown out of solution, is a problem to be met and solved by the manufacturers of the lacquers. Air conditioning cannot help in the lacquer room in this respect, although it may possibly be of assistance in the manufacture of the materials themselves.

A second, but no less important, advantage of air conditioning is that obtained by the removal of all dust from the air brought into the lacquer room. Due to the large quantities of air brought into the room by the exhaust fans connected to spray booths or hoods, the dust problem is particularly prominent in plants located on busy thoroughfares.

We encounter no such difficulties in the plating room where the problem is largely that of maintaining comfortable working conditions for the men. Without question, the proper conditions are conducive to more accurate work, less spoilage due to carelessness, and better morale among the workmen. Such advantages are, however, very difficult, if not impossible to evaluate at the present time, and will continue to be so until more experimental data have been collected bearing on these questions.

The method of producing the required atmospheric conditions is, basically, that of introducing into the room to be conditioned air of the required purity and of such quality that, after the heat and moisture produced in the room have been absorbed, the resulting conditions are those desired. Other requirements of the system, such as the production of the proper air motion without undesirable drafts, the introduction of the air at the most advantageous points in the room, and the like, must be incorporated in the design of the system.

While air conditioning systems may be divided into many classifications, for our purposes they may be classified into two general types: first, as to the method of altering the quality of the air; and second, as to the means used in the distribution of the air to the spaces to be conditioned.

In order to discuss the two classifications suggested, let us first review the problem to be solved. Firstly, any space that could be

conditioned is subject to a gain of heat from, or a loss of heat to, adjoining spaces, the direction of heat flow being dependent on the relative temperatures on the two sides of the dividing partition. This gain or loss of heat would be of sensible heat, or that heat in the air which is reflected in the reading of a common thermometer.

Secondly, the air in the same space is subject to a gain or loss of moisture. A gain in moisture would be caused by the respiration and perspiration of the workmen, by the infiltration into the room of moisture-laded air from out-of-doors, and by the evaporation of water or the liberation of steam into the space. A loss in moisture would be caused largely by the infiltration of dry air from out-of-doors, or by the absorption of moisture by hygroscopic materials. Such a gain or loss of moisture would be accompanied by a gain or loss of latent heat, which is added to the air by the water vapor and which must be removed when the vapor to liquid when dehumidifying.

Discussion of the changes that may occur to air in a conditioned space brings us to the first general classifications of air conditioning systems: that based on the means of altering the quality of the air. Alteration of quality is, obviously, the addition or removal of sensible heat, and the addition or removal of moisture to or from the air being supplied to the conditioned space in order to maintain the desired conditions.

We are all more or less familiar with the methods used to heat air when a loss of sensible heat is encountered, and the method of adding moisture to the air by means of water sprays is too common to require mention here. These two processes are used during the colder months of the year and have been used in connection with ventilating systems for many years.

The methods of removal of sensible heat and moisture are, however, comparatively new, and it is to these that we shall confine the discussion.

There is only one accepted method of effecting the removal of sensible heat: that is by the transfer of this heat to a medium of lower temperature. Such a medium may be a refrigerant such as carbon dioxide, Freon, Carrene, or many others in common use, or it may be water if a source of low temperature water is available. The actual water temperature required will vary with the final air temperature to be produced.

The most common means of removing moisture or latent heat from air at the present time is by cooling the air to such a dew point temperature that the moisture content will be reduced by condensation to the desired quantity.

A second means of removing moisture or latent heat is by the direct adsorption of the moisture by a hygroscopic material such as calcium chloride, silica gel or activated alumina. In the removal of moisture by this means, however, the latent heat released by the condensation of water vapor is absorbed by the air, raising the temperature considerably. It is therefore necessary to after-cool the air by one of the methods described for the removal of sensible heat.

It would not be amiss to state at this point that the application of the hygroscopic quality of the various materials to air conditioning is a comparatively recent development. It is true that there are manufacturers offering equipment using such materials at the present time, but the writer is of the opinion that most of the materials have not yet had sufficient variety of application or years of use to state unqualifiedly that they can replace refrigerants in all cases. In all fairness, however, it should be stated that such materials have almost unlimited possibilities, and would appear to be ideally suited to air conditioning in cases where air of a low moisture content is rquired, and where at the same time the dry bulb temperature is of secondary importance. An example of such a condition would be familiar to all of you, namely, a lacquer room.

The second general classification is that based on the method used in the distribution of the air. The two types of systems falling into this classification are those known as Unit Systems and Central Systems.

As the name implies, the Unit System employs a multiplicity of small systems, located at strategic positions in the space to be conditioned, each being complete in itself in that it includes a means of altering the quality of the air, and a fan for the distribution of the air. Units using a refrigerant or cold water may include a dehumidifying coil only, or they may include a complete refrigerating plant in miniature. When hygroscopic materials are used, they must be included in the unit assembly.

The Central System, as the name also implies, employs a

single equipment for altering the quality of the air, and the air is then distributed to various points in the space to be conditioned.

It will be seen that the classifications suggested are of a very elementary nature, and that they do not begin to take into account the many possibilities of combination. In fact, types of systems under the two classifications may be combined and further subdivisions made. It will be unnecessary for our purposes, however, to go into further detail.

Because of the fact that the cost of installation and operation of air conditioning systems increases with the increase of heat and moisture emission in the conditioned space, it is exceedingly important that such emissions be reduced to a minimum. In addition, the loads imposed by infiltration of outside air or by the exhaust of air from the space must be kept as low as possible.

The major source of refrigeration load in lacquer rooms is the enormous quantity of air that is exhausted through the hoods or spray booths. An amount of air equal to that exhausted must be cooled and dried before delivery to the room. It is therefore of great importance that such exhaust be reduced to the lowest quantity conducive to healthful conditions for the workmen. The requirements of various industrial codes and laws must be observed in this respect. For example, in New York City, sufficient air must be exhausted through lacquer spray booths to provide an average air velocity through the frontal area of the booths of 100 feet per minute, and the exhaust cannot be reduced below the quantity thus fixed.

The sources of heat and moisture in plating rooms are greater in number than in the case of the lacquer room. In this case, we have hot tanks which are double offenders in that they give off heat and moisture at the same time. In addition, there are the various motors, ovens, and the like. In order to maintain a reasonable dry bulb temperature in the room, it is often necessary to insulate the sides and bottoms of all tanks containing hot water or hot baths, and to apply additional insulation to the ovens. The installation of the motors and motor-generator sets in adjacent rooms where possible will also be of advantage. Such changes usually cost very little, and are of great assistance in reducing the heat loads.

The problem of removing the moisture loads caused by the evaporation of water in hot baths and the like is not solved as

easily as is that due to the sensible heat. In this instance, it is generally found to be more economical to install additional exhaust ventilation to remove the moisture before it has had chance to diffuse throughout the room.

There are many possible ways of effecting economies in operation of the system if these possibilities are considered before the design leaves the preliminary state. Such features as the use of cooling towers or well-water for cooling of the condensers, the use of make-up air from adjacent departments, the use of by-product steam or exhaust steam for reheating the air, and many others must be considered. It would be folly to attempt to give general rules to be followed in all particular cases, as each installation must be treated as an individual problem. They are mentioned here solely to give the prospective purchaser of an air conditioning system a general idea of the many problems to be solved before the system can be properly designed and installed.

The selection of hygroscopic material would be dictated largely by a consideration of the installation and operating costs. Both types of systems will produce the conditions desired equally satisfactorily. As mentioned earlier, however, extreme caution is recommended in the use of hygroscopic materials as industry's experience with this type of material has been limited. As in the purchase of any commodity, the company manufacturing and selling the equipment will give a good indication of the results to be expected.

In making the decision as to the type of distribution to be selected, each application must again be considered on its own merits. In the case of lacquer rooms it will be found that in the majority of cases the Central System will be the best. In this particular case, as in most industrial applications, the accurate control of atmospheric conditions is of the greatest importance. In such cases where large quantities of outside air must be introduced into the space to make up for the exhaust, it would be necessary to have an outside air connection to each unit to obtain the accurate control desired. Such a procedure is possible, but generally would not be the most economical method. Many other considerations would militate against the selection of units. It is acknowledged, however, that under special conditions especially in the case of small rooms, units might effect the best installation.

Plating rooms, on the other hand, present a problem dealing

largely with the production of comfortable working conditions, while the accurate control of atmospheric conditions is of secondary importance. Generally speaking, the size of the space to be conditioned and the refrigeration load imposed would be the determining factors in the selection of the type of distribution to be used. The first cost of units versus central systems would be in favor of the units in the case of the small room, while the balance would favor the central system in larger rooms.

It is generally easier to install units when the installation is not to be completed at once, but when a small portion is to be installed at first, with additional portions from time to time. In this respect, units present the most flexible system. It would be recommended that whenever units utilizing refrigeration are to be used, the distribution units be used with a central compressor plant. This procedure eliminates in part the higher maintenance costs of unit systems caused by the multiplicity of motors, drives and other moving parts. This recommendation cannot be applied to units having hygroscopic materials as the dehumidifying medium, as a central point of dehumidification would not be possible.

In order to give an indication of the comparative costs of installation and operation of the types of systems most likely to be considered, figures have been prepared on the basis of an assumed lacquer room and plating room. In each case the costs have been estimated for central systems using a refrigerant and a hygroscopic material. All factors affecting the size of the equipment, and therefore the costs, have been made the same for each system. It must be realized that the costs given cannot, under any circumstances, be applied to prospective installations as it is most unlikely that the design factors would be the same in any two plants.

The lacquer room assumed was one having ten six-foot spray booths, all in operation at one time. It was further assumed that the dimensions of the room were seventy-five feet by twenty feet, that the room was at the top of the building with the roof exposed to the sun, and that one long side was provided with windows.

In the design of the assumed system, it was necessary to select a dew point temperature to be maintained in the room under all conditions. It is obvious that the type of lacquers used, the

amount of retarders added and the original temperature of the work will affect this dew point temperature. In general, however, a dew point temperature of 50° F. would be satisfactory, and this temperature was selected for purposes of comparison. A dry bulb temperature of 85° F. was selected as the optimum when considering the comfort of the men, the rapidity of drying of the work, and the operating costs of the system.

The system as designed for a refrigerant consists of a centrifugal compressor, dehumidifying coils, heating coils, a distribution fan, air filters and the necessary ductwork, controls and accessories. Heating coils are required during the winter, and also during the summer for raising the air from the dew point temperature to a reasonable temperature for introduction into the room without producing drafts, while at the same time absorbing the sensible heat liberated in the room. To those of you familiar with air conditioning, it might be well to add that air from the room cannot be used for reheating the air leaving the coils, because of the low dew point temperature and the great amount of air exhausted through the booths.

The system utilizing a hygroscopic material was based on the use of Silica Gel. The air drawn from out-of-doors is first filtered, then passed through the silica gel chamber where the moisture is adsorbed. The condensation of the moisture is accompanied by the liberation of the latent heat, which heat is absorbed almost entirely by the air. The removal of this heat is accomplished by passing the air through cooling coils through which the coldest water available is circulated. The air is then distributed throughout the room by means of sheet metal ductwork. Heating coils would not be used during the warmer weather with this system, but they are included in the estimated first cost for use during the winter when dehumidification is not required.

The comparative first costs of the assumed systems for the lacquer room are estimated to be as follows:

Refrigerant (Carrene)	$22,000
Silica Gel	$23,000

In the calculation of the operating costs of the systems, the following costs were assumed:

Water	$ .60 per 1,000 cubic feet.
Electricity	.0155 per K.W.H.

Steam	.40 per 1,000 pounds
Gas	.60 per 1,000 cubic feet.

Under these conditions, the comparative costs for one hour of operation of the system at maximum cooling and dehumidifying capacity, including power, water, and so on, maintenance, supplies and repairs, but not including labor, nor allowances for interest on the investment, depreciation, taxes nor insurance would be approximately as follows:

Refrigerant (Carrene)	$2.90
Silica Gel	$2.15

In the design of air conditioning systems for plating rooms, the assumed room was approximately 80 by 25 with windows on two walls. It was assumed to contain the customary hot baths, ovens, motor-generator, and so on.

It was further assumed that proper insulation had been applied to the hot baths and that the chromium bath was provided with an exhaust hood.

In order to reduce the heat loads to a minimum, the exhaust system connected to hoods over the hot baths was assumed as being installed with the air conditioning system, and the cost of such work is included in the first cost of the system.

As mentioned earlier in this paper, the problem in plating rooms is largely that of producing desirable working conditions. The conditions selected as being best from the point of providing the optimum conditions at the least cost were 85° F. dry bulb temperature and fifty per cent relative humidity. It is to be noted that the system would be designed to maintain these conditions in the worst periods of the summer, but that as the out-door temperature and relative humidity recede, the system would be able to maintain a greater differential between the indoor and outdoor conditions than would be indicated during extreme weather.

The systems designed for the plating room contain approximately the same equipment as outlined for the lacquer room, the cycle being the same in the two cases. The sole difference lies in the fact that in this instance the use of air returned from the room may be permitted for tempering the air leaving the dehumidifying coils of the system using a refrigerant. The more return air that can be used, the less will be the cost of operation, the difference lying in the saving of steam in the latter case.

Just how much return air can be used will generally be deter-

mined by the quantity of air exhausted from the conditioned space. In other words, a balance must be found between exhausting a maximum amount of air for removing the heat liberated, and exhausting a minimum amount in order to economize on steam consumption. The proper balance is usually dictated by experience and by calculations based on the actual conditions to be encountered.

The comparative costs of installation of the assumed systems for the plating room are estimated to be as follows:

Refrigerant (Carrene)	$8,000
Silica Gel	$9,000

The calculations of the operating costs were based on the same unit costs as were given for the lacquer room. These costs for one hour of operation at maximum cooling and dehumidifying capacity, including the same items as before, would be approximately as follows:

Refrigerant (Carrene)	$ .87
Silica Gel	$ .30

With reference to the operating costs for both types of rooms, it should be stated that the use of the systems was based on weather conditions similar to those encountered in New York City. The hourly cost for systems in different localities would vary quite considerably, as would the *annual* cost of the same system in the same locality for different years.

A word as to the procedure to be followed in selecting and installing an air conditioning system would not be amiss at this point. Experience has shown that it is generally the best plan to obtain competitive bids from various manufacturers or contractors, the bids to be based on a definitely designed plant. Competitive prices based on designs prepared by the bidders are seldom satisfactory, as there may be as many different designs as there are bidders, and the prices cannot be justly compared.

As a final suggestion, by all means be assured that the manufacturer of the equipment selected has specialized in air conditioning and that the contractor selected for the installation has had similar experience. Air conditioning for industrial processes has not yet reached the stage of permitting the sale and installation of a packaged article, and a correctly designed plant may very easily be rendered unsatisfactory if the improper equipment is purchased or if the installation is made in a haphazard manner.

Why Metals Corrode

DR. ROBERT M. BURNS

Read at Bridgeport 1935 Convention

I PROMISED Mr. Gilbertson before I got here this evening that if he would listen tonight, I would cut it as short as possible and try not to put him to sleep.

In most general terms, corrosion may be defined as the chemical reaction of a metal with the constituents non-metallic in character of its environment. Corrosion reactions which are most commonly known as such are represented in the rusting of iron. Everyone thinks of rust at the mention of corrosion, but we all know that other metals as well corrode. It is well to point out, I think, that corrosion is a chemical reaction or series of reactions varied in character. For instance, one might cite the tarnishing of copper or the action of acetic acid on lead to give white lead, the latter a reaction which to the maker of white lead is quite desirable, but to the user of lead sheathed cable is highly unprofitable. The burning of coal is a corrosion reaction, the oxidation of carbon. We are not concerned in this case with the conservation of the material, coal, nor of the products of combustion, but rather in the production of heat. The world about us is a product of corrosion, if we consider silicon and the other metals which have gone from the metallic state to combinations with non-metallic elements.

When we speak of corrosion we generally think of the ordinary environment in which the corrosive constituents are first of all oxygen, moisture, carbon dioxide, chlorides, sulphur gases, and so on and in which the temperature range is approximately from zero to 135 degrees Fahrenheit.

Corrosion may take place in the air, salt waters, fresh waters, soil waters, or in the soil. We might think of other environments. For instance, on some other planet, if chlorine exists in place of oxygen it would be a very corrosive region and under those conditions gold, for instance, would no longer be a noble metal, as it is in our atmosphere because chlorine reacts with gold. Or we might consider still another universe in which the temperature is much higher than our own. If, for instance, the temperature

were around 2,000 degrees Centigrade, we should find that iron would not now corrode or, in other words, would be a noble metal.

The question of why metals corrode may be answered by saying simply that it is the inherent tendency of metals to react with non-metals. The best measure of this tendency is the amount of energy which is liberated in the process. It is a rule of nature that those reactions occur spontaneously in which there is a liberation of energy. The energy liberated in corrosion processes may be in the form of heat or electrical energy or mechanical energy. Generally speaking, in corrosion reactions proper it is liberated as heat. Our attention, however, is focused on the process of the destruction of metal to form corrosive products.

What is of vastly more importance than why metals corrode is how they corrode, the rate of corrosion, for if that rate is extremely slow, we need not worry about it. This rate or driving force of corrosion is not related to the tendency to corrode. That is, those metals which have the greatest tendency to corrode may not actually corrode the most rapidly.

The rate of corrosion cannot be predicted, it must be measured; but the methods of measuring the rate are varied and may involve observation of the rate at which a metal loses weight or loses strength or the change in potential with time in a solution. The rate has to be determined experimentally, because it depends upon the mechanism of the corrosion process. That mechanism generally may be quite complicated and occur in several steps. Naturally, the slowest step in the corrosion process will be the one which controls the rate, and in corrosion that slowest step, that part of the mechanism which generally controls corrosion, is the formation of a film of some sort. So we come to consider then the mechanism of corrosion.

We can roughly divide the mechanism of corrosion into reactions in which there is direct combination of the constituents of the environment with the metal, or reactions in which there is a replacement by hydrogen, either from water or other compounds or the replacement of one metal by another. Under direct combination, high temperature oxidations, which occur readily, are perhaps good examples; others are the reaction of chlorine on metals, and atmospheric tarnish. Indeed, the different metals apparently form films of different sorts and the process is not, in many cases, well understood.

An examination of the rates at which metals gain weight upon exposure to the atmosphere reveals information as to the mechanism of attack. In the case of copper, a parabolic curve is obtained. This indicates a diffusion process; in other words, the rate at which copper corrodes is determined by the rate at which oxygen diffuses through the film first formed. Similarly in the case of zinc, a straight line relationship may be obtained. The film which forms in this case has little effect upon the subsequent course of corrosion.

In the case of lead, on the other hand, the form is somewhat like copper to begin with, but becomes parallel with the time axis. In other words, it apparently builds an impervious film which stops the course of corrosion. Aluminum also behaves in this way. In the case of iron at certain higher humidities, above forty or fifty degrees relative humidity, the film first formed seems to accelerate the rate of corrosion.

The replacement type of corrosion, such as the rusting of iron, is an example of the metal iron replacing hydrogen out of water, or perhaps out of acids as in the case of the solution of a metal in acids. Another common case, of course, is the displacement of copper from a solution of a copper salt by metallic zinc which results upon the immersion of a piece of zinc in such a solution.

The mechanism by which these reactions occur in the presence of moisture is pretty well established to be of an electrolytic character — galvanic cells which appear on the surface of the metal — a process involving the existence of small anodes and cathodes, and the flow of current between them. A great many studies have been made of this process.

In Table I, (See page 37) there are given some of the couples on the surface of the metal, which are involved in the mechanism of corrosion. Corrosion occurs by means of these galvanic couples. As shown, these corrosion cells may consist of a noble metal, in contact with a more base metal, which is represented in an alloy of two different phases, and in which the noble metal behaves as the cathode and the anode is the base metal. Or an oxide forming on some part of the metal surface may behave as a cathode against another area of the metal as an anode; or dust, particularly carbonaceous dust, is generally cathodic to most of the other common metals; or an annealed region of a metal may become cathodic against the strained region which

will be anodic. Similarly, large crystals are cathodic against small crystals which are anodic.

A very common type of corrosion cell that has been recognized in recent years is the differential oxidation cell, which develops when a metal is subject to different amounts of oxygen at different points on the surface. In these cells the regions which are more accessible to oxygen become cathodic to the areas where there is less oxygen. Similarly, we may have metal ion concentration cells. I may point out that with the exception of the first one, these couples which are involved in corrosion do not particularly involve the purity of the metal. They depend more upon the environment of the metal.

The Table II, page 37, represents the fundamental reactions of corrosion cells. At the anode, a metal atom loses an electron and goes into solution as a metal ion, or hydroxyl ions may lose electrons and oxygen plate out in the atomic form. In the second step in the reaction, the atomic oxygen may be evolved in the form of a molecular oxygen or may be reduced by some other means.

At the cathode the metal ion plates out as a metal atom, or hydrogen plates out as it sometimes does in the plating process, and the second step in the cathodic process is that of the removal of the hydrogen. These reactions may be written in the form of an equation. For example, in the solution of the metal, a metal atom plus a hydrogen ion reacts to give a metal ion and atomic hydrogen. The removal of hydrogen may be either by evolution as a gas, in some cases, or by oxidation by oxygen or other oxidants to form compounds, in this case water. These processes may be represented in the form of electrolytic cells in which the metal is one electrode and oxygen or hydrogen is the other, and the electrolyte is a saturated solution of the hydroxide. In the first case the electrolyte is saturated with air, and in the second with hydrogen.

Let us consider the electromotive series of metals arranging the most anodic metals on the right and proceeding to the left with decreasing anodicity (increasing cathodicity or nobility) This arrangement, as you know, is of a good deal of value in determining the relative behavior of metals toward each other, but in that it is a rather special case, it is not of much service in corrosion problems, for this series is an arrangement of the

potentials of metals in solutions of concentrations normal with respect to their own ions.

TABLE I.

NATURE OF COUPLES COMPRISING CORROSION CELLS

Cathode	Anode	
NOBLE METAL	BASE METAL (2 METALLIC PHASES)	
OXIDE	METAL	Do not involve particularly the purity of the metal.
DUST (CARBON)	METAL	
ANNEALED METAL	STRAINED METAL	
LARGE METAL CRYST	SMALL METAL CRYST	
METAL (O_2)	METAL (ABSENCE OF O_2)	
METAL IN HIGH M^+ CONCENTRATION	METAL IN LOW M^+ CONCENTRATION	
METAL IN HIGH H^+ CONCENTRATION	METAL IN LOW H^+ CONCENTRATION	

TABLE II.

FUNDAMENTAL REACTIONS OF CORROSION CELLS

ANODE: $M \xrightarrow{-e} M^+$; $2(OH)/ \xrightarrow{-2e} O + H_2O$; $2O \longrightarrow O_2$ GAS

CATHODE: $M^+ \xrightarrow{e} M$; $H^+ \xrightarrow{e} H$; $2H \longrightarrow H_2$ GAS

EQUATIONS FOR:

SOLUTION OF METAL: $M + H^+ \longrightarrow M^+ + H$

REMOVAL OF HYDROGEN: $2H \longrightarrow H_2$ OR $2H + \frac{1}{2}O_2 \longrightarrow H_2O$

Expression in Form of Electrolytic Cells

METAL EXPOSED TO AIR: $M \mid$ MOH SAT. O_2(0.21 ATM.) $\mid O_2$(0.21 ATM.)

METAL IN ABSENCE OF AIR: $M \mid$ MOH SAT. $\mid H_2$ (1 ATM.)

In a practical corrosion problem, involving two metals, the environment is extremely unlikely to contain the normal concentrations of the ions of both metals. Moreover, any one of the metals here may behave to some extent as a hydrogen electrode, and what we probably get in most of our environments is not purely the potential of the metal, but a composite potential of the metal and a hydrogen electrode.

In active corrosion processes the potentials are influenced by the flow of current, a process known as polarization. This change of potential with the flow of current may be represented schematically very simply.

If a piece of iron and a piece of zinc are immersed in a salt solution, and the potential of each measured by a reference electrode of some sort, there will be certain difference in potential, depending upon the circumstances. Then if zinc is removed from a portion of a strip of galvanized iron, producing thereby a

zinc iron couple, and potentials measured as before at points most distantly removed, it will be found that the potentials of the iron and zinc areas are very much like those of the single pieces of these metals, but if the potentials are measured at points approaching each other, i. e., approaching the interface of the two metals, it will be found that the potentials come closer together, until at the interface there is a very small potential difference between iron and zinc. If we had some means of measuring the current , we should find that there was a certain flow of current which increased in density as the interface was approached. In other words, it would be possible to plot a curve which would demonstrate the change in potential of the metals.

Polarization may occur in corrosion cells either at the anodes or the cathodes, or at both. Since the limiting corroding current is determined by the intersection of the anode and cathode polarization curves (assuming no resistance of the electrolytic path between the electrodes), a knowledge of the character of these polarization curves is of value in the study of corrosion processes. The amount of metal corroded depends upon the amount of current flow, but the character of the corrosive attack, that is, whether uniform solution or pitting, depends upon the distribution and size of the anodes. If the anodes are widely dispersed and equal approximately in total area to the cathodes, the metal will be corroded uniformly.

If, on the other hand, the anodes are relatively few in numbers and considerably smaller in area than the cathodes, pitting will result. The latter is generally the case. In other words, the anodic current densities are likely to exceed the cathodic current densities. Incidentally, this explains why metallic impurities of anodic character may result in pitting, whereas those of cathodic character may be without effect.

Inasmuch as there is a certain finite resistance of the electrolytic path between the anodes and cathodes, the corroding current will be less than that represented by the intersection of the anodic and cathodic polarization curves. In electrolytes of low conductance, this may become an important factor, affecting the rate of corrosion.

We have observed that the potential of lead in a solution exposed to oxygen is cathodic to the potential on the same specimen measured in an atmosphere of nitrogen. This difference of

potential, which is of the nature of that responsible for differential oxygenation cells, appears to be caused by the fact that the cathodic areas are in a higher state of depolarization in the oxygen exposure.

It is not easy to measure these anodic and cathodic current densities and potentials, because of the fact that the areas are seldom known. It, however, is an easy matter to measure the potential of the metal in an environment, as it changes with time. For example, the potential of iron in a potassium sulphate solution may be relatively constant with time at some value 0.3 or 0.4 volt electronegative on the hydrogen scale, and then if a small amount of sodium chromate is added to the solution, the potential becomes more noble at once and much like the chromium steels.

In the absence of the chromate, the potential is determined mainly by the anodic potential of iron in that solution, the cathodic areas being considerably polarized, but upon the addition of chromate the anodic areas are passivated or oxidized and the cathodic areas are depolarized, with the result that the resultant potential of the iron specimen becomes considerably more noble. U. R. Evans has observed this effect experimentally.

It is well known that the potential of steel is ennobled by the addition of nickel and chrome to the alloy. Passive films of this sort are self-repairing, as may be seen if the metal is scratched during the measurement of its potential. At the moment of scratching the potential breaks abruptly in the anodic direction and then more slowly restores itself to the original value.

The change in potential with time often furnished a convenient method of measuring the rate of film formation. For example, the rate of sulfation of lead in sulfuric acid, which is a corrosion reaction involving the rate of film formation, may be readily followed in this manner. The potential remains relatively constant for many hours or even days when high purity lead is immersed in sulfuric acid. The addition of an impurity such as copper either to the electrolyte or to the metal causes an abrupt break in potential to that of copper, the time required for the break to appear depending upon the concentration of copper.

This matter of protection of metals by formation of film is a very important matter to users of metals. Films which inhibit corrosion are continuous in character, adherent to the metallic

surface, insoluble in the surrounding medium. That means that when exposed to rain, the film which is formed does not dissolve and leave the surface.

Protective films are in optical contact with the metallic surface, are impermeable to those corrosive constituents of the environment before mentioned, such as chlorides, oxygen, sulfur dioxide and hydrogen sulfide. Finally, protective films are self-repairing. The film on stainless steel and aluminum, in many environments, is self-repairing, and that means that when it is ruptured or destroyed it may form again and preserve the metal. Where such a film can be had in the environment and it depends upon the metal as well as upon the environment, a high degree of corrosion resistance is shown.

These naturally forming films may actually accelerate corrosion under certain circumstances. They may retain moisture, for instance, and the result is generally a speeding up of the process, or they may screen a part of the surface, thereby localizing the corrosion and causing pitting.

For instance, when the environment contains both a film-forming constituent and a film-breaking-down constituent, represented by a chromate and chloride respectively, the result will depend upon their relative concentrations. If there is a great deal of chromate and a small amount of chloride, the metal will be protected. If there is a very small amount of the chromate with respect to the chloride, the rate of corrosion may be reduced but not prevented. In case of an intermediate value of the ratio to chromate to chloride, part of the surface may be protected, leaving the other part to be attacked by a local action. The regions which are passivated or protected may actually behave as cathodic areas with respect to the unprotected surface which corrodes.

The position of the film with respect to the metal surface is of considerable importance. When lead is exposed to pure water in the presence of oxygen, the lead ions go into solution and hydrogen ions plate out. The result is essentially a solution with lead hydroxide. If carbon dioxide is present at low pressures lead carbonate will be precipitated at an appreciable distance from the lead surface. When acetic acid is present, a great deal more lead goes into solution, owing to the high solubility of lead acetate, and the carbonate is precipitated similarly.

Unless the carbon dioxide pressure is high, the film of lead carbonate exercises little or no protective action.

In the case of silicates, on the other hand, lead is protected apparently because lead silicate within certain acidity ranges is very insoluble. In other words, the silicate ions precipitate out in optical contact with the metal, producing thereby a protective coating. This leads to a consideration of the reason why iron continues to rust when exposed to moisture. The ferrous ions go into solution, and hydrogen plates out, the resulting ferrous hydroxide being relatively soluble.

These ferrous ions get away from the surface before meeting an oxidizing atmosphere, which oxidizes them to the ferric state and precipitates them as ferric hydroxide at some distance from the surface. This precipitated ferric hydroxide film is permeable to oxygen and to other ions present in the solution, particularly chloride ions and consequently affords little or no protection against a continuation of corrosion.

Vernon has shown, however, that it is possible to form a protective coating on iron if exposed to low humidities and screened from dust. He also demonstrated that the ordinary rust film formed in air containing dust has an accelerating effect upon the rate of corrosion of iron at higher humidities.

I mentioned the protective action of silicates on lead. A very common method of inducing protective films on the inside of iron pipe in water supply systems which has been adopted in recent years has been the addition of lime. This results in the formation of an egg-shell precipitate of calcium carbonate which prevents the corrosion of the pipes.

We might also mention heating systems which have been protected by deoxygenation. In that case the hydrogen film on the iron (cathodic polarization) minimizes corrosion. In other systems, such as air conditioning using water spray, many corrosion problems have arisen. It has been necessary in many of these cases to add silicates or chromates or alkalies, tannates in some cases, to reduce corrosion.

Perhaps the best known example of corrosion resistance by film protection is in the field of nickel chromium and copper bearing steels. I have already mentioned aluminum. These are examples in which the rate of corrosion is retarded or inhibited by film formation. The tendency to corrode is unaffected, but the

rate of reaction is markedly influenced. We protect iron by plating with metals which have more suitable film forming characteristics. Chromium forms some sort of an oxide coating in very direct contact with the surface, and, as you know, it is very highly resistant to corrosion. In those cases where we cannot use either plated metals or make alloys which in the certain environments in which we wish to use them do form these films, then we recourse to organic coatings (paints, lacquers, etc.), and that takes us into a field that I do not wish to touch tonight.

To sum up, metals corrode because of their natural inherent tendency to react with non-metals. It is an example of the way nature does things. The more important thing, the more important matter with which we are concerned, is the mechanism of corrosion which affects the rate of corrosion. Probably the future study in the corrosion field is going to have a good deal to do with finding out the nature of these films, how to make alloys with films which resist corrosion. (Applause)

PRESIDENT GILBERTSON Dr. Burns wants to catch a train, but I am quite sure he would be glad to answer any questions that you would like to put to him at this time.

MR. COSGROVE: Where would cadmium fit in?

DR. BURNS: It behaves very much like zinc. It, however, has different film-forming characteristics. We have a roof exposure in which we have subjected the specimens to a water spray on days on which it doesn't rain. Cadmium corrodes more rapidly than zinc under this exposure, owing to the fact that the film, I think, is somewhat more soluble in industrial atmospheres. Of course, the atmosphere would be important in this case. It apparently is true that in marine atmospheres, the film which forms on cadmium is less soluble. I presume that may be an explanation for the fact that cadmium stands up rather better in marine atmospheres than it does in industrial atmospheres.

MR. SAMP: Speaking now of corrosion of iron or steel parts, bright finish, natural atmospheric corrosion, where you have the first formation of the ferrous hydroxide, giving the galvanic effect, can that be largely overcome by placing parts in containers which are decidedly anodic? How much of an effect will that have in overcoming the progressive state? Can it be overcome by having parts in contact, either in the form of a container or other

receptacle, which is decidedly more anodic and have that cell effect largely overcome?

DR. BURNS: I am not quite sure that I understand your question. As I pointed out, if you have something which oxidizes the ferrous salt more rapidly, oxidizes it immediately, it may precipitate it somewhat closer to the surface, and thereby you would expect to get some protective action; but I think your question was whether, if you had an anodic unit present, you could protect the specimens. You mean to have it in contact with the iron part so that you would make the iron cathode?

MR. SAMP: Yes; for example, a number of small parts.

DR. BURNS: Then you would tend to make your iron cathodic with respect to its environment.

MR. SAMP: Will that overcome the miniature cell effect that you will have?

DR. BURNS: Yes; if the conditions are properly chosen, it is quite possible to get what we call cathodic protection. In other words, you can overcome these small anodic areas by making the part cathodic enough. You have to apply enough potential so distributed that your small anodic areas on iron will be completely cathodic.

MR. SAMP: That is largely a matter of area, is it? The contact there with respect to the mass?

DR. BURNS: It is a matter of position of the potentials and that, again, would depend upon the area; yes. I am sorry I haven't got another slide here on which I tried to represent that.

MR. SAMP: With that thought in view, what type of metal would you expect to give the best protection?

DR. BURNS: You would get the protection most easily, I suppose, by having one which is most anodic, such as zinc. You would have to remember that the conductance of your electrolyte would be a factor. That sort of cathodic protection is practiced, as you may know, in a good many special places.

MR. SAMP: Would you expect better protection from aluminum?

DR. BURNS: I would expect better protection from zinc. Of course, your environment would again come in.

MR. MEYER: Dr. Burns, have you any explanation why we get greater corrosion in some cases in distilled water than we get in ordinary tap water?

DR. BURNS: Yes. In the case of some metals, at least, take the case of lead, lead corrodes very readily in distilled water, and does not corrode in tap water nearly so rapidly, and this appears to be principally due to the silicate content of tap water. Indeed, you can suspend ordinary powdered silica, shake it up in a solution of distilled water, and enough of it will dissolve to completely protect lead, which ordinarily would be badly corroded in distilled water. With distilled water, in other words, you do not have the proper film-forming materials present to protect the metal. Of course, the necessary film-forming material would depend upon the metal you were trying to protect. Obviously, a metal which had a quite soluble silicate film would not be protected by adding silicate, but by adding something else which formed a very insoluble salt with it.

MR. SAMP: It is pretty well recognized that chromates do, under certain conditions, have beneficial effects by establishing film. Have you, in your experiments or experience, developed any other salts, oxidizing salts, that would have a similar beneficial effect in reducing corrosion either natural or galvanic, depending upon which theory you assume for that?

DR. BURNS: That, of course, depends upon the metal.

MR. SAMP: I am speaking of steel or iron.

DR. BURNS: That is a problem which a good many people would like to have more light upon, but they do know that silicates have a protective action on iron. Tannates are sometimes used, and sometimes combinations of silicates and chromates are used, but apparently chromate is about the most protective common material to use for protecting iron in a water solution. There, again, if the water or solution which you desire to protect iron in is corrosive, that is, if it has chloride in it, it requires more and more of the chromate, as I have tried to indicate, to furnish the protection. But I do not know offhand anything better for that particular condition.

MR. SAMP: Should the solvent be slightly on the acid or the alkaline side?

DR. BURNS: It should be on the alkaline side. You will find, I think, that in some cases if it is on the acid side chromates will not protect. In other words, it will require a greater amount to protect. The smaller amount apparently will protect if it is

on the alkaline side. That change is very abrupt as you go from the acid to the alkaline side.

MR. FRANKLIN STOCKTON: (Standard Steel Spring Co., Coraopolis, Pa.): About a year or two ago, some of the alcohol and glycerine companies began to advertise that their products were anti-corrosive for use in automobile radiators. Can you tell us what they employed in alcohol and such things as that as anti-corrosives in automobile radiators?

DR. BURNS: I do not know, of course, what they may have used, but it is well known that such a simple thing as a sugar solution will reduce the corrosiveness of a salt solution. I think you can show that if you put a piece of steel in a salt solution. It corrodes very readily. But if you put in a good deal of corn sugar, it cuts it down considerably. It may be that they have used corn sugar. However, I do not know what it could have been in the case of which you speak. There are quite a number of such inhibiting agents in the organic chemical field. Quinoline is an example. These substances act as inhibitors rather than passivators. Generally speaking, where the action is at the anodic areas we speak of it as passivating, although I do not think that term is always used that way.

Inhibiting agents are things which tend to stabilize the cathodic polarizations. Any substance which increases the viscosity of a solution or forms a film which causes the hydrogen to stay in place, or which may prevent the depolarizer of oxygen from going up to the surface, will tend to stabilize the cathodic polarization. There are quite a number of things that have been used in so-called inhibitors in certain solutions to prevent attack.

MR. ARTHUR E. THURBER: (Rochester, N. Y.): Sodium dichromate has a tendency to prevent or retard the action of sulfur on silver. Have you an knowledge as to the permanence that might be expected from such resistance?

DR. BURNS: No, I do not. That is an interesting observation. I do not know, unless it forms a pure oxide film. Tarnish which occurs on silver seems to be a film made up partly of sulfur and partly of oxygen; that is, a sulfide oxide film, in many cases, and the reason it keeps on growing and looks unsightly is because that film which forms is rather porous and builds up into thick layers.

It is apparently an open structure which permits the reaction

to continue. Under some other conditions, it has been observed on copper that this same tarnish will form in an air containing sulfur, but when pure air containing no sulfur is allowed to react on copper, it forms a more protective oxide film, and that may be what you are getting in this case. I do not know. You may be getting an oxide film which is protecting it from sulfur tarnish which ordinarily occurs.

MR. THURBER: You would not expect it to be very permanent or long lasting?

DR. BURNS: No, I should not in that when it was injured, you might expect the sulfur fumes that were present to attack it. I do not know. It might be of some value, though. There are other people here who know a great many things about corrosion. I think they ought to get into this discussion. There is Dr. Blum, for instance. Perhaps I am not answering all of these questions correctly. I generally learn a good deal at any corrosion meeting from the experiences of other people.

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Nearly 100 Field Service Representatives of Oakite Products, Inc. will meet at their headquarters office in New York, December 9th to 13, 1935 in connection with the Annual Technical Sales Conference.

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The Abstract Section

PATRICK J. SHEEHAN, *Chairman, Program and Educational Committee*

Coloring of Iron by Oxidizing Agents in Caustic Soda. (Farbüng Von Eisen in Natronlauge Mit Oxidationsmitteln) H. KRAUSE - *Die Metallwaren - Industrie und Galvano,Technik* Vol. **33,** #18, pages 393-4 — The coloring of iron objects by immersion in molten salts gives durable and protective coatings, but the process has certain disadvantages in the high temperature and high drag-out which are attendant with the process. Caustic soda baths with the addition of oxidizing agents have proved to be satisfactory. Strong caustic solutions (35-40%) to which are added sodium peroxide to make a 10% concentration are satisfactory when operated near the boiling point. Saltpeter (sodium nitrate) may be used in place of sodium peroxide. These solutions color iron brown or black. A solution of sodium salts of nitriphenol and gallic acid with an excess of alkali is also recommended for producing a deep black on iron. WALTER R. MEYER

Metal Cleaning by Tumbling and Burnishing. By N. RANSOHOFF, *Metal Progress*, Vol. **28**, No. 3, page 57, Sept. 1935 — The methods of cleaning metals by tumbling and burnishing and preparing them for further operations are discussed by the author. The drum type of the automatic cleaner is gone into quite thoroughly; the operation and construction being told in detail. The four principle objectives of tumbling are stated and the means of getting these objectives are given. The author also states the advantages and disadvantages of the different kinds of tumbling machines. Burnishing by means of stars, balls, soap and water, leather, and sawdust is discussed and precautions for doing successful work are given. WM. GEISMAN

Corrosion Testing Methods by H. E. SEARLE and F. L. LaQUE. Paper presented at June Meeting A. S. T. M. — The authors draw the conclusion that corrosion tests in order to be practical should be done on the field. The means and a device for doing this is described, and the method of making this device is told so that it may be reproduced. This apparatus was in use eight years and it has proven itself very practical. The author gives examples of how the device has predicted performance in service. He also suggests that standarization of field testing will be of greater importance than a standardization of laboratory testing equipment. WM. GEISMAN

Polishing and Buffing of Stainless Steels. By R. S. LEATHER. *Metal Cleaning and Finishing*, September, 1935 — Inherent properties of stainless steels necessitate the development of special finishing procedures. Hard artificial abrasives of uniform grain size and fast cut have given best results. For retention of luster it is essential the surface be free of foreign metallic particles, non-metallic inclusions and various imperfections. Proper selection of the sequence of grits is important.

The article includes a table summarizing the various finishing operations. There is a bibliography suggesting technical literature for those wishing to investigate the subject in greater detail. E. T. SHEEHAN

The pH Control of Electro-Plating Baths. By W. R. KENNY and A. B. REED. *Metal Cleaning and Finishing*. September, 1935. — Plates for many years have used the calorimetric method of pH determination in nickel baths. "Bromcresol Purple" is the indicator generally used for the pH range from 5.2 to 6.8. Many large laboratories, however, use electro-metric equipment for determining pH values. Confusion has arisen due to the fact that calorimetric methods give an average reading of .5 pH higher than the electrometric results. Understanding of this face and adherence to a basic method of control, should eliminate any doubt as to accuracy from the plater's mind.
E. T. SHEEHAN

Grinding and Polishing Aluminum and its Alloys. A. V. ZEERLEDER - *"Aluminum,"* Vol. **17,** May, 1935. pp. 245-51. — The facility with which a metal can be polished depends more on the uniformity, structure and properties of the individual crystals than on its hardness. A softer metal with fine uniform crystal grain can be polished better than a harder metal of less uniform surface. A table gives tensile properties of aluminum alloys. The speeds for various materials are discussed. Polishing agents, varnishes and treatments are discussed. PHIL J. RITZENTHALER

Chromium Plating with Solutions containing Hydrofluoric Acid. K. ASSMANN - *"Chemiker-* Zeitung - Vol. 91. **59,** Feb. 27, 1935. pp. 177-8 — A solution containing 350g CrO_3 and 3g potassium fluoride/liter used at 3.8 - 4.0 volts and 40-60 amperes 1 sq. foot with electrodes 12 cm. apart produces chromium deposits at 18-20° centigrade. To obtain similar deposits in sulfate solution temp. would have to be 35-40° Cent. Throwing power of fluoride solution is very good but current efficiency is 9% which is lower than sulfate both. PHIL J. RITZENTHALER

Metal Coloring with Molybdate Solutions. H. KRAUSE - "Mitteilungen des Forshungsenstitus und Probieramts fur edelmetalle, vol. **8,** March, 1935 - pp. 138-143. — Besides the known methods of producing brown to black deposits on metals by electrolytic processes from molybdenum solutions, immersion processes give good results. Molybdate colorings take best effect on zinc. Black is easiest to obtain. With an addition of chloride it is suitable for aluminum. Iron assumes only a fine dark brown color. Cadmium, tin, lead and lead alloys assume slightly irridescent brown or grey tones. The principle baths are:

1. Ammon-molybdate - 5-20g 1 liter (0.60-2.7 or 1 gal) in water slightly alkaline with ammonia.
2. Ammonium molybdate 5-20g/liter (0.6-2.7 ounces/ gallon) with about half amount of sodium thissulfate in place of ammonia.

All colorings stood bending tests well on tensile sides of test strip while on compression side some flaked off. PHIL J. RITZENTHALER

CHROMIUM PLATING LITERATURE
PHIL J. RITZENTHALER

Platers' Guide. Vol. **31,** Jan. 1935 - pp. 14-15 — These installments deal with nickel sub-coats under the chrome plate.

Recent Developments in Electroplating. S. WERNICK. *Journal Society of Chemical Industry,* Vol. **53.** Nov. 9, 1934 - pp. 948-53 - Review of Developments particularly in deposition of ni, chromium, cadmium and the precious elements.

Difficulties in Nickel Plating, by ANDRE DARLAY. *Galvano,* Fe. 1935, page 17 and April, 1935, page 17 — The increasingly more rigid requirements placed upon nickel plating, both as to quality and price, demand closer study and better understanding of its operation. The condition of the bath and the defects in the deposit itself are considered from a practical view-point. The troubles that may be encountered are classified and discussed as to their probable causes, how they show themselves, and their possible remedies.

1. The bath becomes increasingly acid. This condition may arise from imperfect rinsing of work, from passive anodes, or from excess ammonium salts causing crystallization at the anodes. It is evidenced by white anodes, bright clear color of bath, gassing at the cathode, and a smell of ozone around the bath. Among other defects, the deposits become hard, brittle and likely to burn at edges. Additions of nickel carbonate are recommended, in preference to ammonia. Passivity of anodes may be removed by a 30 minute anneal at 750° C, followed by air cooling.

Advocating a neutral bath containing only a single and double salt mixture, the author does not approve the use of chlorides or of weak acids, such as boric. (This will sound rather old-fashioned to most American platers. C.T.T.)

2. The bath becomes increasingly alkaline. This may be due to an excess of chlorides, added as "exciting salts," or to insufficient rinsing after a lye or cyanide cleaning. The anodes become quite black, the deposits are yellow or dark, and pitting occurs. Additions of pure sulphuric acid are recommended. The commercial acid may contain arsenic, a dangerous impurity.

3. Salts crystallize out of the bath. This is caused by an excess of ammonium sulfate. For the "classic formula" of 150 g/l single salt to 50 g/l double salt, the corresponding proportion is 183 g/l nickel sulphate to 16 g. ammonium sulfate. This excess may arise from additions, as "exciting salts", or as ammonia to neutralize excess acid. It may cause passivity of anodes, and may seriously reduce "throwing power." The baths in this state should be run warm, and have subsequent additions of single salt only until the proper proportions are restored.

4. The bath becomes turbid and of bad color. This trouble is rare with simple baths of single and double sulfate only, but is frequent when various

other salts are present. It is due generally to too low a nickel content as analysis will show or as its color may indicate. The deposits become rough and hard to polish. Analysis of the bath should point out the remedy. This condition should not be confused with that of a bath containing suspended sediment, which may be cleared up by filtration.

5. Other bath defects. On long standing idle, surface mold may develop on the bath, due to fermentation of organic matter, present as pollution in water, or as "brighteners" added to the bath. To remove, the bath should be filtered, and then treated with salicylic acid or bichloride of mercury. (*To be continued*). C. T. THOMAS.

Electrodeposition of Tin Alloys from Alkaline Stannate Baths, by R. G. MONK and H. J. T. ELLINGHAM. Trans. of the Faraday Soc., Vol. XXXI, Part 10, p. 1460, October 1935 — One purpose of this investigation was to define the conditions for depositing alloys of tin that might have the advantages of tin coatings and also be more resistant to abrasion. Satisfactory deposits of tin-nickel alloys containing up to about 25 percent of nickel can be obtained at high current efficiencies from an alkaline bath at 160° F containing 12 to 13 oz/gal of tin present as sodium stannate, 0.25 oz/gal of nickel present as the double potassium nickel cyanide, and 0.7 oz/gal of potassium cyanide. Nickel anodes are used and are practically insoluble under the conditions used. The deposits containing from 18 to 25 percent of nickel, that are obtained at current densities from 1.5 to 5 amperes per square foot, are bright up to a thickness of about 0.005 in. but thicker deposits have a matte appearance. These alloy deposits are about 7 times as hard as those of electrodeposited tin. Deposits of higher nickel content are obtained only with much lower cathode efficiencies and are harder but more brittle than those containing 25 percent of nickel.

Alloys containing tin and antimony in almost any proportion can be deposited with practically 100 percent cathode efficiency from a bath containing sodium stannate and sodium thioantimonate at 160° F by using current densities from 1 to 100 amperes per square foot. All these deposits are very brittle and it is not likely that they will have any practical applications. W. BLUM.

Defective Silver Deposits; Effects of Loading Cements and Sulfur on Silver Plating, by E. RAUB and K. BIHLMAIER. Mitt. Forschungsinst. *Probieramt Edelmetalle* **9**, 29-35 (1935)—It is reported that some of the defects observed in silver plating are due to the materials used for loading or filling the articles. These loading cements may contain rosin, asphalts, oils and brick dust. If they come in contact with the silver plating solutions the rosins and oils may partly dissolve and cause streaks and poor adherence of deposits, especially if the bath contains much free cyanide. The difficulty is reduced by using a lower current density or a higher temperature. Wherever possible therefore the loading of articles should be done after silver plating. Another defect which causes discolored deposits is the presence of silver sulphide which can be detected by the turbidity of the bath. In most cases this comes from the

presence of sulphur in the potassium cyanide. It can be removed by heating the bath and filtering it or allowing the silver sulphide to settle. (Through **C. A. 29,** 6510 (1935).) W. BLUM.

The Use of the Microscope in Controlling Heavy Electro-Deposits. Importance of Uniformity of Crystalline Structure. M. CYMBOLISTE *Rev. nickel* **5,** 160-4 (1934); *Chimie & Industrie* **33,** 884 — In this article it is shown that the crystal structure is of very great importance in affecting the properties of thick deposits. Deposits having uniform mechanical properties are composed of crystals of about uniform size that are arranged perpendicular to the first surface of deposition. If the deposits contain small crystals next to the base metal and a mixture of small and large crystals near the outer surface, hardness tests will show that the mechanical properties are not uniform. Such irregularities may be due to defects in the base metal or to inclusions of solid particles or gases. These defects prevent good adhesion and favor cracking of the deposits. (Through **C. A. 29,** 6510 (1935).) W. BLUM.

Chromium-Plating Inner Surfaces of Iron Objects of Small Cross Section, by N. N. GRATZIANS'KII. *Ukrain, Khem. Zhur.* **9,** 437-40 (1934). Iron objects with an inside diameter of 0.4 in. were plated on the inside with chromium to a thickness of 0.0016 in. in 40 to 60 minutes from a bath containing 30 oz/gal of chromic acid and 0.33 oz/gal of sulphuric acid at 140 to 160° F and a current density of 170 to 190 amperes per square foot. (Through **C. A. 29,** 6147 (1935).) WM. BLUM.

Theory of Chromium Deposition from the Chromic Acid Bath, by A. UMANSKII. *Ukraïn Khem. Zhur.* **9,** 167-9 (1934) — A theory of chromium deposition is proposed in which it is assumed that the chromic acid is first reduced to trivalent chromium, which in the presence of sulphuric acid, forms chromic sulphate. The trivalent chromium is then reduced to metallic chromium. (Through **C. A. 29,** 6147 (1935).) W. BLUM.

Black Chromium-Plating, by A. POLLACK. *Chem.-Ztg.* **59,** 56 (1935)— Black deposits of chromium that have considerable resistance to wear are obtained by replacing the sulphuric acid in the regular chromic acid bath with acetic acid and using a higher current density. (Through **C. A. 29,** 6147 (1935).) W. BLUM.

Electroplating on Aluminum, by JOH. FISCHER. *Siemens Z.* **15,** 83-4 (1935) — It is recommended that the aluminum be prepared for plating by using an anodic acid etch followed by an electrolytic treatment in alkali. Nickel plating is recommended for the first coating, to be followed by any other desired coating. (Through **C. A. 29,** 6147 (1935).) W. BLUM.

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Business and Social News — BRANCH NEWS — Educational Activities

LOS ANGELES BRANCH

Minutes of the regular monthly meeting of the Los Angeles Branch A.E.S. held Sept. 11th at the Rosslyn Hotel. Vice-Pres. E. R. Williams presided.

The minutes and financial report of the previous meeting were read and accepted.

Letters from Mr. Blanch, our member in Australia, and Mr. Kocour were read.

Bills for per capita tax, postage and convention report were read and ordered paid.

The question of delinquent members was discussed. The board of managers was instructed to contact all delinquent members and set a specified time up to which delinquent members could remain in good standing by paying the per capita tax on the amount they were in arrears.

The application of Mr. Hardy of Honolulu was discussed. The branch voted to accept Mr. Hardy as a member when his application was signed by Earl Coffin and Ray Vasquez who had made the acquaintance of Mr. Hardy.

The meeting was turned over to Mr. Merigold who acted as librarian in the absence of Max Golden. The following questions were in the box:

Q. Give formula for nickel solution for heavy deposit without heating.

A. 8 oz. double nickel salts, 4 oz. single nickel salts, 2 oz. boric acid, 2 oz. common salt (NaCl).

Q. What is good to prevent nickel from pitting?

A. Sodium perborate dissolved in muriatic acid and added to the solution in small quantities.

Q. How can you get a blue color on silver?

A. One member reported having developed a blue color on a silver plated article by dipping it in a die cast nickel solution containing sodium citrate.

EARL COFFIN, *Sec.-Treas.*

BOSTON BRANCH

Boston Branch held an open meeting Thursday the 10th at the Hotel Manger, Boston with Pres. Wood in the chair.

Minutes of the previous meeting read, approved; communications read, placed on file. Bill read, approved.

Reports of delegates to the convention were heard and they were thanked for their very fine report.

Pres. Wood made a report that the next meeting will be an open meeting and the speaker of the evening will be Mr. George B. Hogaboom. His subject will be Zinc.

A motion was made that the chair appoint a committee of four to arrange for the annual banquet to be held sometime in February. The following were appointed: Mr. Campbell, Mr. Hardy, Mr. Garrett and Mr. Cahill.

After the regular order of business, we had as the speaker of the evening, Mr. William Cahill. His subject was "Specification Plating," taken from the address of Mr. W. Meyer given before Bridgeport Branch and published in the REVIEW of May 1935.

Vote of thanks was given Mr. Cahill for the interesting talk of his. After this, refreshments were served. Meeting adjourned at 11 P. M.

A. W. GARRETT, *Sec'y.*

WATERBURY BRANCH

Waterbury Branch, A. E. S., held its October meeting in Engineers Hall, Tennant Elwin, President, presiding. A business meeting preceded the educational session at which time applications for membership were received from George C. Kinnick and Alois Huber of the Manning Bowman Co. of Meriden. A communication from the Cleveland Convention Committee was read, outlining some of its plans for the 1936 session of the A.E.S. At the conclusion of the business session, the chairman introduced Mr. Walter Meyer, a member of the A.E.S. Research Committee and chemist at the General Electric Works in Bridgeport, who offered as the subject of his address, "The Role of Kiln in the Electrodeposition of Metals." The address was illustrated by slides prepared by Mr. Meyer, and added much to the interest of the topic. Many of the local members had the privilege of listening to Mr. Meyer at the recent Bridgeport convention, upon which occasion he delivered two papers that evoked much favorable comment. During his discourse and at its conclusion the speaker answered a number of questions, after which Pres. Elwin extended the thanks of the Branch to him.

It was announced that Harold Work of the Aluminum Co. of America, would be the November speaker.

The many friends in this vicinity of Past President, George Gehling, learning of his new assignment, extend their sincere best wishes for a successful career. W. F. GUILFOILE, *Secy.*

HARTFORD BRANCH

The Hartford, Connecticut Branch of the A.E.S. held its regular monthly meeting on Monday evening, October 14, 1935, at the Elk's Club in Bristol, Conn.

The meeting was called to order at 8.30 P. M. with President St. Pierre in the Chair. Minutes of the previous meeting were read and accepted.

Under new business, transfers were granted to Mr. T. J. Murray and Mr. W. E. Seidel from the Hartford to the Springfield Branch.

Mr. H. R. MacFadyen, active member of the Hartford Branch, read a paper on "Practical Copper Plating." The paper as well as the discussion which followed was very interesting.

The Librarian also conducted our first real "Question Box."

The meeting was attended by nineteen members and was adjourned at 10:30 P. M.

V. E. GRANT, *Sec.*

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CHICAGO BRANCH

The regular monthly meeting of Chicago Branch was held October 12, at the Atlantic Hotel, President F. Herbst presiding and all officers present. A new application from Mr. T. H. Dobson read and a committee appointed on same.

Mr. H. A. Gilberston chairman of the Banquet committee reported that the Boulevard Room of the Stevens Hotel had been selected for our 24th Annual Banquet and the North Ball Room of the Stevens Hotel secured for our Educational Session.

Mr. O. E. Servis in charge of the Educational Program assured the branch that he has some very fine papers and this event will be one of the best ever held by Chicago Branch.

Mr. F. J. Hanlon, a member of the banquet committee urges all members to buy tickets as this will be one of the finest banquets and Educational meetings ever attempted by Chicago branch. The Boulevard Room of the Stevens Hotel is very beautiful, and anyone not attending will miss a real treat. The tickets this year have been very modestly priced at $3.00 per person.

Mr. R. Hazucha reported that Mr. H. E. Gillis of Elgin, Ill., had been operated on for appendicitis. Chicago Branch, Officers and members wish to extend their deepest sympathy to Mr. Gillis and hope that he has a rapid recovery back to health.

Mr. O. E. Servis the librarian appointed Mr. C. E. Campbell to conduct the question box at this meeting. Mr. Campbell made a very good job of it as there was a lot of discussion on the following questions.

No. 1. Automatic Nickel plate conveyor for steel parts has no cyanide dip tank, would it be O. K. to use muriatic acid dip when plating brass parts on this conveyor instead of cyanide dip? Both steel and brass parts are plated on the same conveyor separately of course.

Answer. Many suggestions offered, but thought that if a 5% Hydrofluoric acid dip was used in a wood tank that it would be better than either muriatic or sulphuric and would be O. K. for both steel or brass.

No. 2. Is picric acid used in a brass solution? What is its effect?

Answer. Picric acid has been used in some brass solutions, it is a strong coloring agent.

No. 3. How can glue be removed from a cadmium solution, will H_2O_2 do the trick? What harm does it do?

Answer. It was thought that glue could be filtered out if it was filtered several times. It will not do any harm unless there is an excess.

No. 4. How can silver and copper be separated in recovery of gold from a good solution without using a smelting process?

Answer. Percipitate the metals with zinc dust or small sheets of zinc, then pour off liquid and wash the residue and dissolve in nitric acid, wash the residue, and you have the pure gold.

No. 5. What is the best soap to use to ball burnish sheet brass stampings before and after nickel plating?

Answer. Any good neutral soap.

No. 6. Has Rhodium a better reflecting power than silver on reflectors?

Answer. Rhodium is only about 85% the reflecting power of silver when silver is new, but rhodium will stay bright, but the cost of rhodium is a great many more times than silver.

No. 7. What is the best method for ball burnishing zinc plated steel stampings?

Answer. Use about ½ oz. of cyanide in each load with your regular neutral soap.

No. 8. What is good practise of nickel plating Chrome Vanadinum steel tools for a polished chrome finish?

Answer. Clean in Electric cleaner, dip in 5% muriatic acid. Dip for about 5 minutes. Plate in regular hot nickel solution, P. H. 4½, buff, and then chrome plate. One member suggested that a 10% sulphuric dip with reverse current for a few seconds, rinse and then nickel.

No. 9. To what advantage is cobalt plate over nickel plate on cold rolled steel?

Answer. None. *Which costs more—nickel or cobalt?* Answer. Cobalt costs more. *What effect has foods on cobalt?* Answer. About the same as nickel. *Could cobalt be plated in plating barrels like nickel?* Answer. Yes. *Is cobalt plated on steel better to prevent rusting than nickel of the same thickness?* Answer. No.

No. 10. How can you test for free cyanide in a zinc solution?

Answer. By taking 5 C. C. sample of plating solution dilute to 100 c. c. with distill water. Add 1 cc of 2% potassium iodide and 7 cc of 10% caustic titrate with 10N silver nitrate to a faint opalescence. This is the end point.

J. W. HANLON, *Sec.*

NEW YORK BRANCH

The New York Branch resumed their regular bi-monthly meetings this month at the World Building, Park Row, New York City. The first meeting was held on Friday, October 11th, after the summer period, during which one meeting a month was held.

President John Rolff was in the chair with thirty members present. After a short business session, the Librarian, Aaron Englander, took over the chair and announced his plans for a program of lectures and round table discussions for the coming Fall and Winter seasons. In accordance with the program of various subjects of interest relating to plating progress to be treated by representative men affiliated with the Industry who will address the meetings, there will be a review of several papers presented in the past of especial interest to the N.Y. membership. The Librarian has an active committee working with him in this connection and the Branch looks forward to a revival of interest in general relative to the educational features.

After a lively discussion on current matters and several problems brought up by the members, the meeting was adjourned at 11 o'clock P. M.

F. J. MACSTOKER, *Sec.*

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PHILADELPHIA BRANCH

The Philadelphia Branch held its regular monthly meeting on Friday, October 18th, with President Al.Hirsch presiding. A very good attendance was present. Previous to the business session, President Al. Hirsch gave a very interesting and instructive talk and demonstration of "Faraday's Law," which was well received by all present. These lectures and talks are being held commencing at 7.30 P.M. preceding the regular meeting. Mr. Jos. L. Dinan, Jr. also gave a very good paper on "Lacquers and their application"which was very good, and we want to say right here if Joe keeps on going the way he started (this was his first paper and talk) it wont be long before he will make the old timers step along some. During the "Question Box" discussion, a question was asked as to what is the best method of direct Nickel Plating on cast aluminum and the question was still left open.

It was also asked "What would be the best pickeling methods before hot metal tinning." It was suggested they use a muriatic acid pickle, rinse in cold and hot water, and then dip in hot molten tallow before going into the molten tin.

Two applications were received for active membership. Three applicants were elected to active membership. Let's keep going and any member knowing of any prospective applicants, please notify Mr. Jos. Underwood, or Secretary Gehling.

The Banquet and Yearly meeting will be held on November 23, 1935 at "ADAMS" and the committee has done everything to make both the Educational Meeting and the Banquet worth while for everyone and we are expecting all our old friends together with lots of new ones to be with us on this occasion. The following Guest Speakers and their Subjects will attest to the interest that will be found at the afternoon session.

Chas. H. Proctor - Founder of the American Electro-Platers' Society. Subject - "The Chromium Plating Solution Controversy and Fink Patent."

Frank C. Mesle of Oneida Ltd., Oneida, New York. Subject - "Measuring the Thickness of Electrodeposits of Silver Plated Tableware."

Dr. Wm. Blum, U. S. Bureau of Standards, Washington, D. C. Subject - "Applications of Mesle's Chord method for measuring the Thickness of Electrodeposits."

Mr. M. Marean - E. I. DuPont de Nemours & Co., Wilmington, Del. Subject - "Solvent Degreasing and Metal Cleaning in Modern Electro-Plating Practice."

Mr. W. M. Phillips - Research Engineer, General Motors Corp, Detroit, Mich. Subject - "Pictorial Study of Plating Solutions."

Don't forget the date - Saturday 2.30 P. M., November 23, 1935. Place - "ADAMS" 13th and Spring Garden Streets, Philadelphia, Pa. BANQUET at 7 P. M.

GEORGE GEHLING, *Sec'y.*

DETROIT BRANCH

A regular meeting of the American Electro-Platers' Society, Detroit Branch was held in the Prince Henry II Room, Hotel Statler, on Friday evening, October 4, 1935.

The meeting was called to order at 8:00 P. M. by President W. W. McCord. The minutes of the previous meeting were read and approved. There were two applications for membership: Mr. John A. Maguire, Oakite Products, Inc. 10-255 General Motors Bldg., who made application for Associate Mem-

bership, and Mr. Jas. Wm. Higgins, Chief Chemist, c/o Packard Motor Car Co., who made application for Active Membership in the Detroit Branch.

Both applications were referred to the Board of Managers for action, to report at our next meeting.

A transfer was accepted from the Chicago Branch: Mr. R. Harr, 810 Beard Ave., Detroit, as an Associate Member.

We then had a paper from Mr. Pace of the Miller Corporation of Grand Rapids, Michigan. The title of his paper was "Filtering Electro-Plating Solutions." The paper was very well read and enthusiastically received. It was illustrated with slides. This paper will be published in the REVIEW in the near future. At the end of his paper, there were quite a few questions asked and answered, and Mr. Pace was given a hearty vote of thanks for presenting the paper.

No questions in the Question Box.

At our next meeting we are to have a three-sided debate as a sort of try-out for our future meetings. The names for the debate were not given out but will be published in the notice of our next meeting. We are looking forward to something interesting to be brought out in these debates and anticipate a great deal of entertainment and information to be gleaned therefrom.

The Meeting adjourned at 9:30 P.M.

Respectfully submitted,

T. C. EICHSTAEDT, *Sec.-Treas.*

MILWAUKEE BRANCH

The Milwaukee Branch A.E.S. regular meeting was held Thursday night, Sept. 12. An excellent attendance enjoyed a very fine meeting. We had five visitors. While we have not had an application for membership this month, we are starting our membership drive with a booster meeting. A meeting with all the trimmings, a fine educational session — "The Use and Manipulation of the Miscroscope." This will be topped off with lunch and refreshments. We are looking for every member present this month, which will start our fall meetings off with a bang.

Our librarian and assistant librarian have promised real educational meetings this winter.

R. C. BINDER, *Sec.-Treas.*

CLEVELAND BRANCH

The regular monthly meeting of The American Electro-Platers' Society was held at Hotel Carter.

The meeting was called to order by our president, Mr. W. D. Scott at 8:15 p. m. The minutes of the September meeting were approved as read.

An application for active membership made by Mr. Michael Hyduke of the Empire Plating Company, was turned over to our board of managers.

Mr. Singler of the Hotels Convention Committee reports progress.

Mr. Thompson of the Advertising Committee reports progress.

Motion made and seconded that Mr. Thompson keep record of his disbursements for the convention and the Branch pay him when able.

Our General Chairman, Mr. Ter Doest, made a motion that our Convention Committee meet at 6:30 the night of our regular meeting, and if not able to attend, send in a report to be read.

A paper was then read by our Librarian, Mr. Ter Doest. Our experience in "Cadmium Plating" in a barrel by Austin Fletcher," which brought out much discussion.

After some discussion on P H., meeting adjourned.

W. E. O'BERG, *Sec.*

ST. LOUIS BRANCH

Regular Meeting of St. Louis Branch A.E.S., was held Friday, October 11, 1935.

Dinner was served at 6:15 P. M. Roll call of Officers showed one absent. Minutes of previous meeting read and approved. Letter read from Cleveland Branch stating what they are doing for the coming Convention. They sure are on the job.

St. Louis Branch has made some inducements to get some new members. For the next three months we will admit them by paying one years dues in advance.

Mr. Richards who has just passed his 70th birthday was there drinking his coffee. Mr. Williams stated that as Mr. Richards was one of the standbys of St. Louis Branch when he was Editor and that besides his Educational features he used to put in the REVIEW, he would also find time to think up some poems to give you food for thought.

Mr. Williams then made a motion that Mr. Richards be made an Honorary Member of St. Louis Branch, it was seconded by Mr. F. P. Menninges. Mr. Richards responded with a short talk after which meeting was turned over to Dr. Stout of Washington University, who we look upon as our Chief Chemical Advisor, who listens to our tales of woe, and is always ready to answer our questions. He gave us a talk on Electro Plating and what happened in solutions. Interesting, and as one expressed it was not an aeroplane talk, something that goes over your head, but seeps right in. Something that everyone can understand, for which we all join in and thank him.

Mr. Paul Miller came all the way from Evansville, Indiana for this meeting. We are always glad to see him, and I hope he gets something out of our meeting that fully repays him for his long trip.

Next meeting to be held at the City Plating Company, November 8, 1935, 8 P. M., 2208 Wash Street, St. Louis, Missouri.

Meeting adjourned 9:45 P. M.

C. T. MCGINLEY, *Sec.*

P.S. When does the REVIEW go to press?

In answer to Mr. McGinley's question—all copy for the REVIEW should be in the printer's hands not later than the 28th of each month.

Congratulations Mr. Richards on your birthday. Many happy returns and "when you feel a verse coming on" we will gladly publish same. — *Editor*

SPRINGFIELD BRANCH

The regular meeting of Springfield Branch was held on Monday evening, October 28. Mr. George B. Hogaboom was the speaker. His subject was Bright Zinc Solutions. After giving a detailed account of how cadmium is produced, the speaker told us of the tests made by the Research Committee and the results of these exposure tests at Sandy Hook, Washington, Pittsburg, Florida and New York, particularly as regards zinc and cadmium. A long and interesting discussion followed Mr. Hogaboom's address.

This was the best meeting held so far, there were 55 present representing at least twenty manufacturing concerns in Springfield and vicinity.

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Membership Report

To October 18, 1935

ELECTED

James Clay Hardy, P. O. Box 2395, Honolulu, T. H.
Associate, Los Angeles Branch

George E. Collins, McKinney Mfg. Co., N. S. Pittsburgh, Pa.
Active, Pittsburgh Branch

N. H. McKay, 1100 Pitt Street, Wilkinsburg, Pa.
Active, Pittsburgh Branch

John L. Nelson, 1617 North St., Philadelphia, Pa.
Active, Philadelphia Branch

F. B. Gotthardt, 62 Glenwood Ave., Stratford, Conn.
Associate, Bridgeport Branch

Frederick Fulforth, Box 96, Roslyn, Pa.
Active, Philadelphia Branch

Paul Mentzer, 138 W. Godfrey Ave., Philadelphia, Pa.
Active, Philadelphia Branch

Harry Keller, 4742 Benner St., Philadelphia, Pa.
Active, Philadelphia Branch

Mr. William Mester, 1010½ Harding Drive, Toledo Ohio
Active, Toledo Branch

APPLICATIONS

John W. Himes, Bustleton Ave., Somerton, Philadelphia, Pa.
Active, Philadelphia Branch

John Mullins, 25 E. Fornance St., Norristown, Pa.
Active, Philadelphia Branch

T. H. Dobson, 766 S. Dee St., DesPlaines, Ill.
Active, Chicago Branch

J. H. Maguire, Oakite Products Inc.,
10-255 General Motors Bldg., Associate, Detroit Branch

J. W. Higgins, Packard Motor Car Co., Active, Detroit Branch

Michael Hyduke, Empire Plating Co.,
Active, Milwaukee Branch

Alois Huber, c/o Manning-Bowman Co., Meriden, Conn.
Active, Waterbury Branch

George Clifford Heinrich, c/o Manning-Bowman Co.
Meriden, Conn. Associate, Waterbury Branch

DIED

John A. Storm, 1044 3rd Street, Fullerton, Pa.
Philadelphia Branch

RESIGNED

Mr. George E. Vibberts, Active, Hartford Branch

Mr. B. M. Griffith, National Casket Co., Reedsdale St., N. S.,
Pittsburg, Pa.

TRANSFER

Mr. Frank J. Clark, Hartford Branch to Springfield Branch

R. Harr, Chicago Branch to Detroit Branch

T. J. Murray, Hartford Branch to Springfield Branch

W. E. Seidel, Hartford Branch to Springfield Branch

SUSPENDED

J. Schulein, 832 S. Central Ave., Chicago, Ill.
Chicago Branch

RESOLUTION OF THE EXECUTIVE BOARD AMERICAN ELECTRO-PLATERS' SOCIETY

WHEREAS the Almighty in His Infinite Wisdom has seen fit to remove from our ranks one who has been of inestimable value to the Industry at large and a guide and counselor during the infancy of this organization:—

The Executive Board of the American Electro-Platers' Society has instructed the Secretary to have inscribed in the annals of the organization the name of Palmer Hall Langdon as a memorial to our deceased Honorary Member.

His name lives in the memory of those who have profited by his inspiration and association.

The heartfelt condolence of the entire membership goes out to his wife and family in our mutual loss.

Executive Board

THOMAS F. SLATTERY — P. J. SHEEHAN
H. A. GILBERTSON — WM. J. R. KENNEDY
JOSEPH E. UNDERWOOD — E. STEEN THOMPSON

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A COMBINATION

- PLATER
- BURNISHER
- TUMBLER

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